ELECTRICAL REVIEW

ILLUSTRATED.

A WEEKLY JOURNAL OF

Electric Light, Power, Telephone, Telegraph and Scientific Progress.

VOL. 16, No. 9. WEEKLY.

NEW YORK, SATURDAY, APRIL 26, 1890.

$3 per annum. Single Copies, 10 Cents.

Copyright, 1890, by ELECTRICAL REVIEW PUBLISHING COMPANY, 13 Park Row, New York.

Entered at Post Office, New York, as Mail Matter of the Second Class.

Decision in Pan-Electric Case.

(Special Despatch to ELECTRICAL REVIEW.)

WASHINGTON, D. C., April 21.—The decision of District Supreme Court in Pan-Electric case requires Garland and his associates to restore to Rogers all his patents, except those relating to telegraphy and telephony. The affairs of the Pan-Electric Telegraph and Telephone Company not involved in this case. GEO. C. MAYNARD.

Keyboard Punch of Hollerith's Electric Tabulating System.

In our issue of January 26th, 1889, we described at some length the apparatus used by Mr. Herman Hollerith in his "Electric Tabulating System." Since then, this system has been put to an elaborate series of tests by a commission appointed by the Superintendent of Census, and as a result of these tests, the system will be used in compiling the population statistics of the next census. As a card must be punched for each individual reported, it is apparent that about 65,000,000 such cards will need to be punched. This, of course, involves a considerable amount of labor, and for the purpose of facilitating this, the keyboard punch, which we illustrate herewith, has been devised.

This punch consists essentially of a base upon which is mounted a frame or cardholder in which the cards can be readily placed. In front of this cardholder is a celluloid keyboard with a number of holes, each of which is lettered and numbered according to a pre-arranged scheme. At the back of the base is a swivel in which a swinging arm is held so that it can be swung from right to left and backward and forward. Mounted in this swinging arm is a die and punch, which latter is secured to a lever pivoted to the swinging arm, as shown, and extending over the celluloid keyboard, at which end it is provided with a pin, adapted to enter the holes in the celluloid keyboard, and a knob or handle, so that by depressing the knob a hole is punched in the corresponding position in the card. The holes in this keyboard are laid out in such curves, that by moving the pointer or handle along them, the punch will move in straight lines parallel with the edges of the card.

The lettering and numbering on the keyboard is arranged in groups by heavy lines, in same manner as was formerly printed on the cards, as illustrated in our article above referred to.

The cards used for the purpose of transcribing the individual records of the census will be made of thin manilla stock, 3¼ inches wide and 6⅝ inches long. They will be perfectly blank except a printed number, which serves to identify the given card, if necessary. Besides this number, the cards will be provided with a number of holes punched by means of these keyboard punches. These punch marks will designate the race, whether white, black, mulatto, quadroon, octoroon, Chinese, Japanese or Indian; the sex, the age, the conjugal condition, in case of females, whether a mother, and if so, how many children, and how many of these living; the place of birth; the place of birth of mother; if foreign born, the number of years in the United States; whether naturalized or not; the profession, trade or occupation; the number of months unemployed during the census year; whether the person attended school or not during the census year; whether able to read; able to write; able to speak English, if not, what language spoken; whether suffering from acute or chronic disease; whether defective in mind, sight, hearing or speech; or whether maimed, crippled or deformed; whether a prisoner, convict, homeless child or pauper; and, finally, whether a soldier, sailor or marine during the civil war, or widow of such person.

These inquiries are made in accordance with the requirements of the Act of Congress, and must be compiled in various combinations. This will be done by means of the electric tabulating and sorting machine which we described and illustrated last year.

Vitiation of Air by Different Illuminants.

The following table is taken from *Modern Light and Heat* and shows the consumption of oxygen and air, and the production of carbon dioxide and heat under similar circumstances for the series of 11 illuminants. The very important sanitary advantages possessed by the electric light are strikingly exhibited by the comparisons shown in the table:

Burnt to give light of 12 candles equal 120 grains per hour.	Cubic feet of oxygen consumed.	Cubic feet of air consumed.	Cubic feet of CO_2 produced.	Cubic feet of air vitiated.	Heat produced in one pound of water.
Cannel Gas	3.30	16.50	2.01	217.50	198.0
Common Gas	5.45	17.25	3.21	348.25	278.6
Sperm Oil	4.75	23.75	3.33	356.75	238.5
Benzole	4.45	22.30	3.54	376.30	232.6
Paraffine	6.81	34.05	4.50	484.05	361.9
Camphene	6.65	33.25	4.77	510.25	325.1
Sperm Candle	7.57	37.85	5.77	614.85	351.7
Wax Candle	8.41	42.05	5.90	632.25	393.1
Stearic Candle	8.82	44.10	6.25	669.10	374.7
Tallow Candle	12.00	60.00	8.73	933.00	305.4
Incan. Elec. Light	None	None	None	None	13.8

"Good Morse."

The REVIEW has received a number of inquiries as to "What is good 'Morse'?" Mr. Fred. Catlin, a recognized authority on technical telegraph matters, was asked the question, and his reply is as follows:

"'Morse,'" said Mr. Catlin to a REVIEW representative, "is the term applied to the quality of the work done by an operator in transmitting a message. Of course, every operator sends 'Morse,' either good, bad or indifferent."

"What are the distinguishing characteristics of good 'Morse'?"

"When the dots, dashes and spaces used in the Morse alphabet are of the proper size, perfectly discernible and easily read, we say an operator sends good 'Morse.' If the message is received on a sounder, the ear is depended upon to judge the quality of the 'Morse,' but if the message is received on the tape of a ticker, the quality may be observed by the appearance of the printed slip."

KEYBOARD AND PUNCH—HOLLERITH ELECTRIC TABULATING SYSTEM.

The Electric Fan.

With the approach of warm weather, we take our thin clothing out of the cedar chest, where it has lain all winter, secure from the ravages of the moth, look over last year's ice bill, and go through various other preliminaries preparatory to the summer campaign. And yet, how comparatively few there are who know how cooling comfort may be obtained for a trifling expense, even during the torridest days. By the aid of an electric fan outfit, a whole office may be kept at a delightful temperature, day and night, if necessary. These little machines consist of an electric motor with a fan, shaped like a propellor, attached to one end of the armature. The fans on the ordinary sizes are about a foot in diameter, and the whole apparatus occupies less than a cubic foot of space.

Their operation is entirely unattended by danger, and the power required to drive them is about equivalent to that needed for one incandescent lamp, the cost for current being approximately the same. The only pre-requisite to their use is that an electric current shall be available, either from the service wires in the street, from a dynamo in the building, or from a storage battery. In case a building is supplied with incandescent electric lights, it is only necessary to remove one of the lamps from its socket and substitute for it a plug, with which the wires to the fan motor are connected.

They are almost noiseless, giving forth a soothing, buzzing sound, which is rather agreeable than otherwise, and reminds one of the lazy droning of bees on a hot day. In large apartments or a house, two or more small fan motors may be used, or the same result may be obtained by using a motor of somewhat larger size with an 18 inch fan. All manufacturers make these motors to run from arc circuits as well as from incandescent circuits. Larger sized motors are built in connection with blowers and exhaust fans designed to ventilate engine and boiler rooms.

These fan outfits are an especial comfort to the man who is confined to a desk, as they are easily moved about and can be used right on the desk. When placed on a shelf, near the ceiling, an agreeable current of air may be kept up throughout the room. The average cost of the smaller sizes ought not to exceed $40 set up ready for business.

The catalogue of the Massachusetts Institute of Technology has been received. The corps of instructors has been materially increased, and a rapid growth in the number of students is noted. There are 909 names in the catalogue, counting regular and special attendants. The course in electrical engineering at this college is so well and favorably regarded, that it needs no testimonial from us. Professor Charles R. Cross is at the head of this department, and this is a guarantee of the thoroughness of instruction.

BOOK NOTICES.

"Almanack-annuaire de l'Electricité et de l'Electro-chimie," has been received from the publishers Firmin Leclerc, 72 Rue Louis-Blanc, Paris. This is the sixth year of its appearance and it is a valuable volume for American firms doing business in France, Belgium and Switzerland.

"Spon's Engineers' Tables" is a little booklet, just the size for your vest pocket. It is by J. T. Hurst, and is in the tenth edition. It is a splendid reference book for all the every-day questions which concern an engineer. Many minutes of time may be saved by consulting this little work.

"Practical Electrical Notes and Definitions," By W. Perren Maycock, is published by the same firm. This is a book for the practical man and the student, containing simple and concise definitions of electro-technical terms. In addition, are the rules and regulations to be observed in electrical installation work, as issued by the Institution of Electrical Engineers, and the Phœnix Fire office.

A verbatim report of the Eighth Annual Meeting of the American Street Railway Association has been received. This pamphlet gives a full account of the business transacted at the meeting held in St. Paul, last October. The frontispiece is a steel engraving of Mr. George B. Kerper, of Cincinnati, the president of the Association. The next meeting will be held in Buffalo, N. Y., on October 15, 1890.

"Practical Electrics" is the title of a handy little volume on every-day electrical matters. It is a book of 135 pages, well printed and serviceably bound. The work is addressed more especially to the large class of scientific amateurs who dabble in electrical matters. It is full of suggestions and forms a convenient reference book for those who have electric bells, telephones, or electric lights in their houses. Published by E. & F. N. Spon, 12 Cortlandt street, New York.

"Electrical Engineering," by Slingo and Brooker. This is a valuable work published by Longmans, Green & Co., London and New York. It is a book written especially for electric light men and students, embracing the branches prescribed by the city of London and the Guilds Technical Institute. Both the authors are well-known English electrical engineers, and both are professors at the Telegraphists' School of Science. The book contains about 600 pages illustrated with more than 300 engravings.

"J. A. Berly's Universal Electrical Directory, for 1890," has been received from the publishers, William Dawson & Sons, London. This is the ninth year of its publication, and a marked improvement is to be noted with each successive appearance. The present volume contains about 100 more pages than the last book, all of which is new matter. All the American, British and Colonial branches of the electrical industry are thoroughly represented. It is a valuable universal directory.

The very latest is a game of chess by telephone.

The Electrical Section of the Census.—Progress of the Work.

TO THE EDITOR OF ELECTRICAL REVIEW:

The following schedules have been completed, and a copy is now ready for the printer:

LIST OF SCHEDULES.

1. Manufacturers of electrical apparatus, instruments and supplies.
2. Electric light and power central stations.
3. Fires caused by electric currents. Information to be obtained from electric central station companies.
4. Fatal casualties occurring on electric currents. Information to be obtained from electric central station companies.
5. Fires caused by electric currents. Special investigation in cities of 10,000 population and over.
6. Fatal casualties occurring on electric currents. Special investigation in cities of 10,000 population and over.
7. Isolated electric lighting and power plants.
8. Educational institutions. Electrical engineering courses.

The schedule for central station companies required infinitely more work for its preparation than any other. While in preparation it was shown to a large number of managers of central station companies and others, and full benefit has been taken of every suggestion offered. Every possible effort has been made to render it full, plain, complete and practical. The range of inquiries in the complete schedule necessarily covers all apparatus and service that a central station company may have in use or render.

THE ELECTRICAL SUBDIVISIONS OF THE SCHEDULE.

1. Underground conduits.
2. Underground conductors.
3. Aerial conductors.
4. Incandescent lamps.
5. Arc lamps.
6. Converters.
7. Accumulators.
8. Meters.
9. Stationary Motors.
10. Current supplied to motor cars.

To avoid sending a company inquiries that do not pertain to its business, the schedule will be printed in sections. To ascertain what sections to send to each company, the following inquiries are being sent out to be answered at once:

1. Do you own or operate underground conduits?
2. Do you operate incandescent lamps?
3. Do you operate arc lamps?
4. Do you operate a converter system?
5. Do you operate an accumulator system?
6. Do you operate stationary electric motors?
7. Do you operate or supply current to electric motor cars?
8. Are you making, or do you contemplate making, additions to your plant during the year 1890? If so, please state of what the additions will consist, and give the total amount of estimated cost.

The last question is intended to make "the pigs stand still until they are counted."—See editorial note, ELECTRICAL REVIEW, Jan. 11, 1890.

The returns from the preliminary schedules sent out in February and March are quite satisfactory. An official directory of electric central station companies is now being compiled from these schedules and all other sources of information at command. If any company has failed to return the preliminary schedule, it will oblige the office greatly by doing so at once. In case a company has failed to receive this schedule, one will be forwarded at once if it will kindly give notice of the fact. All companies are earnestly requested to notice carefully the way their names are written on all papers addressed to them, and to make needed corrections in their replies. With such assistance, and due diligence in the office, a creditable degree of correctness may be attained.

The schedules that have been prepared outline only a portion of the work. To subdivide the inquiries for manufacturers, directories are being compiled, classified as follows:

DIRECTORIES OF MANUFACTURERS.

1. Dynamos.
2. Motors.
3. Incandescent lamps.
4. Arc lamps.
5. Carbons.
6. Insulated conductors for electric currents.
7. Conduits.
8. Primary cells.
9. Accumulator cells.
10. Electric meters.
11. Electric clocks.
12. Electric welding apparatus.
13. Electroplating machines.
14. Electric fire alarms.
15. Electric burglar alarms.
16. Electrical apparatus for use in medicine and surgery.
17. Electrical instruments.

Extended as this list is, it requires many additions to make it complete.

A letter has been addressed to each manufacturer, requesting him to assist in furnishing information for a chapter in the Census Report, on the "Manufacture and Uses" of the special apparatus named. This letter solicits:

1st. A list of all manufacturers of the apparatus.

2d. A list of the addresses of all users of the apparatus, when this is practicable, together with a statement of the purposes for which it is being used.

3d. A full description of any novel or special use being made of the apparatus.

4th. Suggestions of pertinent inquiries for a schedule to be sent to manufacturers and also for a schedule to be sent to users of the apparatus when desirable, for the purpose of obtaining information considered to be important.

It is very clear that this invitation affords manufacturers an opportunity to furnish information, the publication of which will be a revelation, not only to laymen, but to those most familiar with the progress being made in adapting electrical energy to the services of civilized life. Such a publication will vastly increase popular knowledge and appreciation of the advantages and value to be derived from the manifold uses of electricity. It will furnish a solid basis for all arguments. Its impersonal and impartial character will convince the public of its truth. It will set at rest all doubts and fears. Future public action guided by it and dealing with electrical interests, will be intelligent and consistent with the people's welfare. A truthful statement, showing what electricity is doing, as it will be told in these chapters and others to be formed, will be enormously valuable to the people of this country.

The day is not distant when the economic value of applied electricity will be known to exceed that of the output of all mines of gold and silver; its ministration to health to be more potent than all other remedies; and when all peoples will be made neighbors and friends by its matchless power to convey intelligence and persons. When that day comes, he who attempts to cast odium upon any form of the apparatus through which electricity manifests its helpful power, or seeks to block its progressive development by raising false danger signals, will be known and shunned as an enemy to public welfare.

ALLEN R. FOOTE,
Special Agent.

Washington, D. C., April 14.

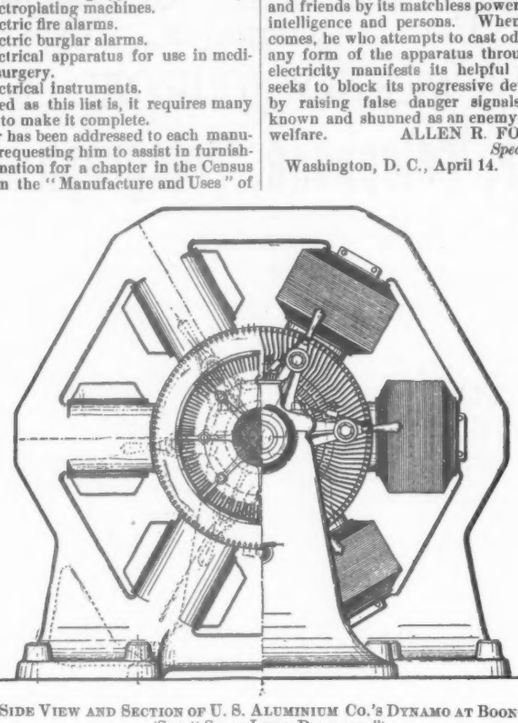


FIG. 1.—SIDE VIEW AND SECTION OF U. S. ALUMINIUM CO.'S DYNAMO AT BOONTON, N. J. (See "Some Large Dynamos.")

The New Insurance Company.

The Electric Mutual Insurance Company, whose prospectus appeared in a recent issue of the ELECTRICAL REVIEW, will be ready to issue policies May 1. It is reported authentically that the company has upward of $2,000,000 insurance already pledged. The high standing and wide-spread popularity of the promoters of the new enterprise ensures its success. Offices have been established at No. 85 Water street, Boston, Mass.

That Niagara Power Company.

"English capitalists are at the point of taking out a mortgage on the water power of the Canadian Niagara Falls. An eminent English electrician and well-known capitalists of England are behind the scheme. The object, it is stated, is to get electricity for transmission to cities and towns, as a motive power and for lighting purposes. The lessees are to pay $35,000 yearly rent. A deposit of $10,000 has been made with the commissioners, which is to be forfeited unless a contract is finally closed and the balance of the first two years' rent paid by March 1, 1891. It is stated that ex-Governor Cornell is interested in the scheme. The syndicate will be opposed by the Hamilton Company, known as the Niagara Hydraulic Electric Company, incorporated in Virginia, with $20,000 capital.

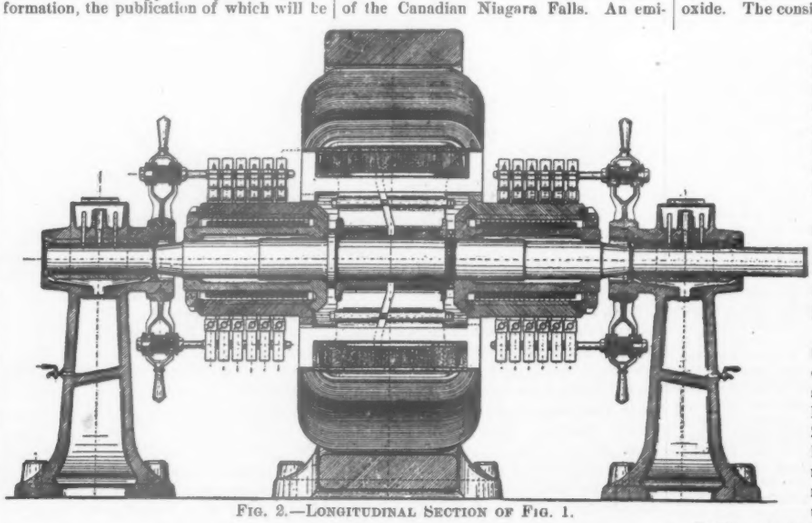


FIG. 2.—LONGITUDINAL SECTION OF FIG. 1.

Some Large Dynamos.

The United States Aluminium Company is the American company which operates under the patents of P. L. E. Herault for the manufacture of aluminium and its alloys. A small experimental station at Boonton, N. J., is now being worked, but in a short time a larger plant will be built at a place not yet decided upon.

The invention of Mr. Herault relates to the reduction of aluminium, silicon and other metals, from their refractory oxides, and to simultaneously alloying them with any and all other metals which do not volatilize under their melting points; such as gold, silver, nickel, tin, copper, iron. Its greatest commercial application at present is the alloying of aluminium with copper and iron. It is also possible to obtain directly mixed combinations; as a combination of copper, silicon and aluminium, by charging the crucible with any silicate of alumina instead of with simple alumina. The process is electrolytical; *i. e.*, it consists in the decomposition, by electricity, of the refractory oxides (the refractory oxide alumina, chemically designated as Al_2O_3), in the presence of the metal to be alloyed.

The transformation is effected in a carbon crucible, which forms part of an electric circuit, consisting of dynamo machines (or other source of electricity), proper conductors (including a carbon block serving as the anode) and the crucible itself. The melted mass of oxide takes the place of the electrolyte in an ordinary voltaic couple. The reduced metal at the bottom of the furnace constitutes the negative electrode or cathode, and a carbon block the positive electrode or anode.

In the process, the heat of the electric current is economically utilized to melt (preparatory to decomposition) the refractory oxide to be reduced and the metal to be alloyed. The electrolytical process may be conceived of as taking place simultaneously with the fusing of the materials constituting the bath; the released metallic molecules traveling downwards and becoming merged with the molten metal to be alloyed, thus resulting in a complete and homogeneous amalgamation.

An important and economic feature of the process consists in the slow combustion of the highly heated anode, which is attacked by the oxygen liberated from the refractory oxide. The considerable thermal heat thereby generated supplements and reinforces the electric power, with, consequently, a material saving at the source of energy. It is estimated that for each kilo of the anode thus consumed, one kilo of aluminium is produced.

An object sought to be obtained is the production, at the first operation, of as high a percentage of aluminium in the bronze as possible.

The dynamo shown in the first three drawings is one of the C. E. L. Brown system, built by the Oerlikon Machine Works, near Zurich. It is of the 120 kilo-watt type, runs at 180 revolutions, giving a current of 6,000 amperes at 16 to 20 volts.

In Fig. 4 is shown the plant of the Swiss company now operating at the Falls of the Rhine. At the experimental plant in Boonton, as well as at the Swiss plant, the dynamos are directly coupled to turbine wheels mounted upon horizontal shafts. The field magnets of these dynamos are excited by a smaller machine, driven by a belt from a pulley on the main shaft.

—— The White Plains, N. Y., Gas Company and the White Plains Electric Light Company have consolidated under the corporate name of the White Plains Gas Light Company.

Determining Distance by Electricity.

Lieutenant Fiske, of the United States Navy, has invented an instrument to determine the range of an object, which is no less ingenious than important. The general principle—that of determining the distance by the difference of angle at which it appears from the extremities of a known base line—is well known, but in Lieutenant Fiske's instrument the difference of angle is determined with accuracy and rapidity by means of a Wheatstone bridge, and either a sensitive galvanometer or a telephone. In practice two telescopes are mounted at a known distance apart, and focused on the object whose distance is to be determined. They will, of course, make an angle with each other. A simple electrical arrangement with galvanometer or telephone in circuit is so arranged that a current will flow through the instrument, unless the two telescopes are exactly parallel. The observer notes on one of the two telescopes the angle required to prevent a current from passing through the instrument, and thus measures or rather electrically weighs the difference in the angle. Thus, a single observer, with an unlearned assistant, can determine with great rapidity the exact distance of a vessel or other object. As designed, the range-finder is intended for use in naval warfare to allow accurate firing of great guns, but if it proves as satisfactory in practical use as is claimed, it should prove far more useful in the pursuits of peace, where the determination of the exact distance of inaccessible objects is often of great importance.

A Disgusted Citizen.

"Hurrah for the electric road! Hip, hip, hur—!" said an enthusiastic citizen in the crowd, as the first car on the electric road passed over the track. His enthusiasm was not seconded and only a few people noticed him, and the manner in which he was regarded indicated that the crowd thought he was rattled. He retired to the shadow of the bank, saying: "Well, this is the worst I ever saw. People march down the street and scream themselves hoarse for a candidate for a four-dollar office, but when we have a practical demonstration of the success of one of the most important enterprises the city has ever known, no one says a word." and the disgusted citizen spit on a fly across the sidewalk, drowning the insect at the first volley.—*San Jose News.*

Paris Electric Meter Competition, 1890.

The following regulations have been issued for the electric meter competition inaugurated this year by the Paris Municipal Council:

1. The competition is open to all inventors of electric meters, for use with continuous currents, alternate currents, or both.

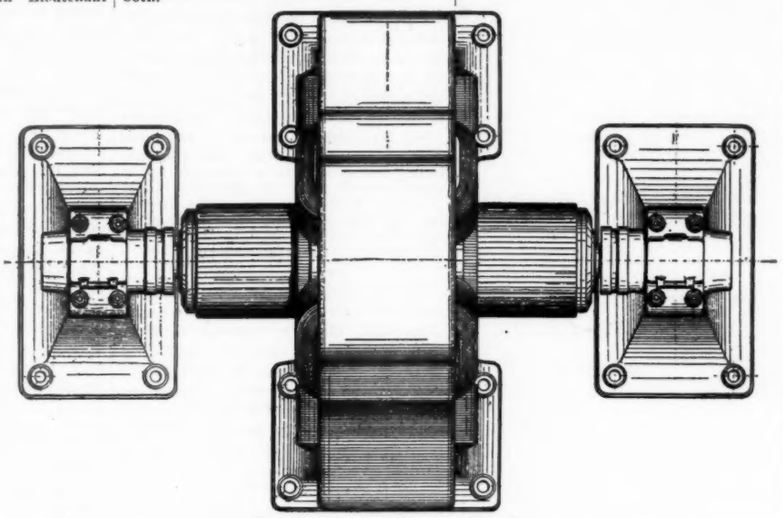


FIG. 3.—GROUND PLAN OF FIG. 1.

2. The apparatus sent in may be either coulomb meters or watt-meters.

3. The meter must be direct-reading, and the consumer should be able to ascertain for himself the amount of current consumed.

4. The meters must register small currents; coulomb-meters should act when only .2 ampere passes; watt-meters should act for a consumption of 20 watts.

5. The meters, accompanied by a description, must be sent under a sealed cover to the office of the Sub-Director of Works, at the Hotel de Ville, before the 31st of August next.

6. The meters sent in will be submitted to a committee composed of nine members, five of whom will be appointed by the Municipal Council, and four by the Administration.

7. The apparatus will be submitted to comparative tests as to accuracy throughout the whole of their range, practical efficiency (regularity of working, simplicity, cost, etc.), energy absorbed in working, and disturbance occasioned by their use in a system of distribution.

8. A sum of 13,000fr. will be distributed as follows: 10,000fr. to the inventor who produces a meter giving complete satisfaction and equally applicable to alternate or continuous currents. If the meter is only applicable to one of the two kinds of current, the inventor will only be entitled to half the premium. Premiums not exceeding 2,000fr. will be awarded to those meters designed both for continuous and alternate currents, and 1,000fr. to those meters suitable only for one kind of current which show the greatest advances.

A Large Number of New Street Railway Contracts.

The Sprague Electric Railway and Motor Company have closed a large number of contracts for the electrical equipment of street railways during the last month. These contracts came from all over the country, a large number of them being noticeably from street railway companies which already have a number of cars in operation upon this system.

The most recent contracts for car equipments, taken by the Sprague Company, are as follows: Augusta Street Railway, Augusta, Ga., 16; Paducah Street Railway, Paducah, Ky., 9; Fort Worth & Arlington Heights Railway, Fort Worth, Tex., 8; Troy & Lansingburgh Railway, Troy, N. Y., 12; Metropolitan Railway, Portland, Oregon. Passenger & Belt Railway, Lexington, Ky., 4; Atlantic City, N. J., Electric Railway, 1; Detroit, Mich., Rouge River & Dearborn Railway, 4; Union Street Railway, St. Joseph, Mo., 6; Sioux City, Iowa, Street Railway, 5; Dallas, Tex., Rapid Transit Railway, 1.

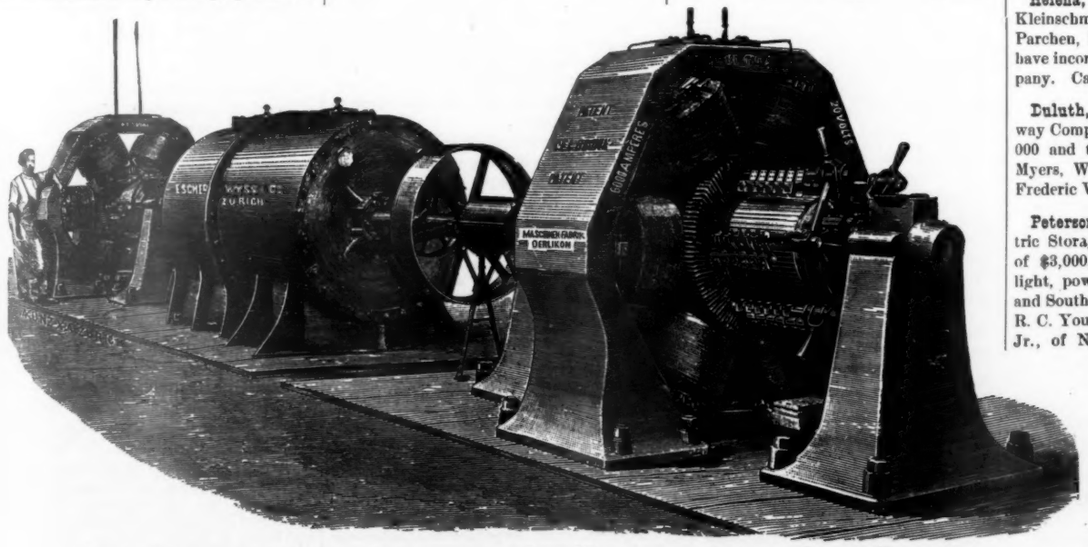


FIG. 4.—TURBINES AND DYNAMOS AS OPERATED BY THE SWISS METALLURGICAL SOCIETY IN LAUFFEN-NEUHAUSSEN.

Marysville, Cal.—The Marysville, Cal., Electric Light and Power Company has been organized. Jos. Heyl, C. A. Glidden, N. V. Nelson, John Peffer, Theodore Niesen, W. F. Kelly and James O. Rusby, directors. The capital stock is $20,000.

Rockville, Conn.— Merchants' Electric Company; capital, $25,000.

Cuero, Texas.—Citizens' Telephone Company; capital, $50,000.

Zanesville, O.—The Zanesville Electrical Street Railway Company; capital, $50,000.

Lancaster, Pa.—The Lancaster and Lititz Electric Railway Company; capital, $50,000.

New Bedford, Mass.—Turner Electrical Manufacturing Company; capital, $5,000; J. M. Turner, president; H. W. Parker, treasurer.

Morristown, Pa.—The charter of the Ashbourne and Cheltenham Electric Light, Heat and Power Company, with a capital of $10,000, has been recorded.

Oregon, Ill.—The Oregon Electric Light Company; to furnish light, heat and power; capital stock, $5,000; incorporators, F. G. Jones, P. E. Hastings and J. C. Fesler.

Collinsville, Ill. — Collinsville Electric Light, Heat and Power Company; capital stock, $25,000; incorporators, Louis Lumaghi, George Hadfield, T. J. Thomas.

East St. Louis, Mo.—The Automatic Electric Exchange Company; to manufacture electrical apparatus; capital, $100,000; incorporators, W. H. Ford, A. Leslie and H. Overstolz.

Saratoga Springs, N. Y.—The McCrary Electric Supply Company, with a capital stock of $50,000; for the purpose of manufacturing lamp shades, reflectors and electrical supplies.

Skagit, Wash.—Fidalgo City Land Company, county of Skagit, Wash. Capital stock, $200,000. Trustees, Julius S. Potter and Joshua Price. Object, to build steam and electric railroads.

Helena, Mont.—A. M. Holter, T. H. Kleinschmidt, R. H. Kleinschmidt, H. M. Parchen, E. W. Knight and Herman Ganz, have incorporated the Helena Electric Company. Capital stock, $100,000.

Duluth, Minn.—The Duluth Electric Railway Company. The capital stock is $200,000 and the incorporators are, Jacob R. Myers, Wilmot Saeger, Henry F. Myers, Frederic W. Payne and Benjamin F. Myers.

Peterson, N. J.—The Consolidated Electric Storage Company, with a capital stock of $3,000,000. The object is to furnish light, power and heat, in the United States and South America. The incorporators are, R. C. Young, B. T. Iseck and C. A. Senior, Jr., of New York; R. N. Robieson, of Astoria; and W. J. Turner, of Sterling, N. J.

Leavenworth, Kan. — The Leavenworth Electric Railway Company. Directors: J. A. Borard, Kansas City; S. S. Nelley., J. R. Braidwood, Robert Garrett, Leavenworth; John H. Bovard, Kansas City. Capital stock, $100.000.

Newark, N. J.—The Consolidated Electric Storage Company. The capital is $3,000 000. The company proposes to furnish light, power and heat, in Camden and East Orange, and in other parts of the United States, as well as South America; to manufacture electric accumulators for cars, vessels and manufactories, and to construct electric railroads. R. C. Young, B. Y. Isecke and C. A. Senior, Jr., of New York; R. N. Robinson, of Astoria, and W. J. Turner, of Sterling, are the incorporators.

ELECTRICAL REVIEW

Published at 13 Park Row
P. O. BOX 3329.

GEO. WORTHINGTON, - - Editor.
CHARLES W. PRICE, - Associate Editor.
T. J. McTIGHE, Electrician and Manager Patent Bureau.

REGISTERED CABLE ADDRESS:
"ELECTVIEW," NEW YORK.
"546 JOHN," TELEPHONE CALL.

BOSTON OFFICE:
W. I. BARKER, Room 29, 620 Atlantic Ave.

WASHINGTON OFFICE:
GEO. C. MAYNARD, 1419 New York Ave.

CHICAGO OFFICE:
D. B. DEAN, 61 Metropolitan Block.

EUROPEAN OFFICE:
CHARLES FFRENCH, Bridge House, 181 Queen Victoria St., London, E. C.

SUBSCRIPTION TO THE ELECTRICAL REVIEW.

One Year, United States and Canada, - $3.00
One Year, Foreign Countries, - - 5.00
Single Copy. - - - - .10

ANNOUNCEMENT.

Address all communications and make all money orders and checks payable to order of ELECTRICAL REVIEW, P. O. Box 3329, New York.

No attention will be paid to communications for the REVIEW without the *name and address of the writer.*

NEW YORK, APRIL 26, 1890.

CONTENTS.

	PAGE.
Decision in Pan-Electric Case	1
Keyboard Punch of Hollerith's Electric Tabulating System	1
Vitiation of Air by Different Illuminants	1
The Electric Fan	1
"Good Morse"	1
Book Notices	1
The Electrical Section of the Census—Progress of the Work	2
The New Insurance Company	2
That Niagara Power Company	2
Some Large Dynamos	2
Determining Distance by Electricity	3
A Disgusted Citizen	3
Paris Electric Meter Competition, 1890	3
A Large Number of New Street Railway Contracts	3
New Corporations	3
The New York Naval Militia	4
Deptford	4
"Urgent" or "Deferred"	4
Correspondence:	
Our Boston Letter	5
Our Washington Letter	5
Our Chicago Letter	5
Our Philadelphia Letter	5
The New Orleans Telegraphic Tournament	5
Telephonic News	6
Great Telephone Work	6
Telephone Rates in New York City	6
A Change on the Part of a Telephone Man	7
Mexican Telephone Company	7
Telephone Service—Mandamus	7
The North East Street Railway, of Kansas City	7
Delany's Speed Indicator	7
Phonograph in Washington	7
Battery Experiments	7
Electrical Equipment of the Steamship "Majestic"	7
Another Storage Battery	7
Telegraphic	7
Who Knows Where It Is?	7
Electric Power	8
The State Senate Committee Investigates	8
Thomson-Houston	8
The Connecticut Motor	8
A Final Telephone Dividend	8
A Peep into the Twentieth Century	8
Obituary	8
The New England Electric Exchange	9
Our Albany Letter	9
Rejecting Electric Light Bids	9
Personal	9
Electric Light News	9
Electric Clubs:	
New York Electric Club	10
Chicago Electric Club	10
Boston Electric Club	10
Harvard Electric Club	10
"The Evolution of the Electric Railway"	10
The Brooklyn Edison Station	11
Kindred Interests	12
Westinghouse Union Switch Company	12
The Production of Copper	12
Using Natural Power	12
New Power Station	12
New Offices of the Thomson-Houston Electric Company, Boston, Mass	12
Better than an Electric Light	13
Killing Rats by Electricity	13
Electrical Patents	13

INDEX OF ADVERTISERS.

COVER PAGES.

Ansonia Brass & Copper Co	4
Armington & Sims	4
Bridgeport Brass Co	4
Brush Electric Co	3
Davis, Charles H., Electrical Engineer	4
Day's Kerite Insulated Wires	4
Eastern Electric Cable Co	4
Edson Pressure Recording Gauges	4
Hampson & Co., E. P.	4
Jewell Belting Co	4
Moore, Alfred F	4
Okonite Co	2 and 4
Simplex Electrical Co	4
Standard Underground Cable Co	4
Tucker Electrical Construction Co	4

INSIDE PAGES.

Aluminum Battery Electric Light & Power Co	20
American Bell Telephone Co	22
American Electrical Works	14
Babcock & Wilcox Co	30
Baird & Co., Henry Carey	13
Baker & Co	14
Ball Electric Light Co	21
Ball Engine Co	22 and 27
Baxter, H. E. & C	28
Bishop Gutta-Percha Co	27
Blanchard, C. M	14
Brownlee & Co	30
Brush Electric Light and Power Co	15
Buckeye Engine Co	25
Butler Hard Rubber Co	15
Cary & Moen	30
C., B. & Q. R. R	15
"C. & C." Electric Motor Co	16
Central Electric Co	30
Clark Electric Co	14
Continental Dynamo Co	30
Cutter, George	14
Daft Electric Light Co	26
Dwight Slate Machine Co	30
Easton Electric Co	19
Eclipse Wind Engine Co	25
Eddy Electric Manufacturing Co	15
Edison Machine Works	28
Edison Lamp Co	31
Edison Manufacturing Co	16
Edwards, S	13
"Electric"	13
Empire China Works	32
Empire City Electric Co	19
Eugene F. Phillips Electrical Works, Ltd	14
Eureka Tempered Copper Co	24
Excelsior Electric Co	23
Faraday Carbon Co	24
Fort Wayne Electric Co	32
Foundry and Machine Dept., Harrisburgh Car Manufacturing Co	31
Garvin Machine Co	25
Gassner's Dry Battery	25
Gethins Electrical Manufacturing Co	23
Goodrich Rubber Companies	24
Gordon & Co., W. H	14
Greeley & Co., The E. S	15
Hammond Typewriter Co	21
Heisler Electric Light Co	20
Holmes, Booth & Haydens	23
Horn, Brannen & Forsythe Manufacturing Co	22
Ide & Son, A. L	15
"Industries"	26
Interior Conduit and Insulation Co	30
Jarvis Engineering Co	25
Lane & Bodley Co	24
Leclanche Battery Co	14
Leffel & Co., James	30
Lehigh Valley Creosoting Co	22
Lynch, E. T., Jr	14
Macfarlane & Co., Wm	14
Marshall, Wm	13
Mitchell Vance & Co	27
National Carbon Co	21
National Tel. Manufacturing Co	13
Newark Machine Tool Works	14
New England Butt Co	25
New York Belting & Packing Co	24
New York Electric Supply Co	14
New York Insulated Wire Co	27
Ostrander & Co., W. R	22
Page Belting Co	13
Parker-Russell Mining and Manufacturing Co	24
Partrick & Carter	19
Pennsylvania Railroad	21
Phœnix Glass Co	14
Phosphor-Bronze Smelting Co., Ltd	24
Pond Engineering Co	25
Post, Jr., & Co., John	25
Powell Co., The Wm	27
Queen & Co., James W	14
Railway Directory Publishing Co	15
Rice Automatic Engine	25
Ricketts Co., Limited (F. M.)	24
Royce & Marean	24
Santley & Co., W. R	15
Sawyer-Man Electric Co	29
Schoverling, A	28
Schuyler Electric Co	31
Seely Taylor Manufacturing Co	28
Shultz Belting Co	25
Southern Electrical Supply Co	19
Solar Carbon and Manufacturing Co	27
Sperry Electric Co	24
Sprague Electric Railway & Motor Co	32
Stephenson Co., Ltd	28
Stevens & Babcock	24
"Street Railway Journal"	21
Taber, Arthur H., Agent	13
Thomson-Houston Electric Co	18
Thackara Manufacturing Co	30
Trinidad-Heimann Insulated Wire Co	21
Tropical American Telephone Co., Ltd	21
Tucker Electric Construction Co	32
United States Electric Lighting Co	17
Vincent & Co., Charles R	25
Washburn & Moen Manufacturing Co	24
Watson & Stillman	22
Western Electric Co	15
Westinghouse Machine Co	25
Weston Electrical Instrument Co	27
Whipple Co., Fred. H	30
Williams & Potter	25
Wilson & Co., R. D	13
Wyckoff Pipe Co	14

La Lumière Electrique applauds the action of the New York Electric Club in passing unanimously a resolution expressing its sympathy with the efforts of American authors and publishers in favor of an early passage of the International Copyright Bill. "The Electric Club shows by this resolution," says our Paris contemporary, "its appreciation of the fact that all true electricians should ever march in the vanguard of progress."

The Spanish Government has made application for the admission of the telegraph offices which it maintains in Cuba, Porto Rico and the Philippine Islands, into the forthcoming international telegraph conference to be held at Paris next month. Negotiations are also being undertaken with the different submarine cable companies landing in these colonies, with a view to securing more favorable rates than those at present existing.

The action of the gas commissioners in rejecting the bids of the electric lighting companies for illuminating this great metropolis, shows plainly the character of the men who handle the reins of government in this city.

By what name shall we designate the actions of the officials who, after imposing restrictions upon the light companies which materially increase the cost of production, then call for bids from these companies and when they find a slight increase, due to their own acts, calmly reject all the bids and return to the obsolete method of illumination in use 20 years ago? Such pin-headed politicians are better fitted to rule in a Jersey village of 500, than in a city of a million and a half inhabitants.

"The Cheapest Light" was announced by the programme of the National Academy of Sciences as the title of a paper to be presented by Professor Langley, the secretary of the Smithsonian Institution. Electric light promoters were startled, principals were telegraphed for, visions of bankruptcy filled the minds of gas stockholders, and everybody waited to learn what great discovery was about to be promulgated by the most learned body of scientists in the country. Relief soon came, when inquiry developed the fact that the professor's paper was a dissertation on the light of the firefly as viewed through a spectroscope.

The advantages of the electric railway over the old style horse cars are no longer theoretical. The more the results of experience are studied the clearer it appears that there is great economy in the substitution of electricity for horse-power on street car lines. The managers of the St. Louis street railway system stated recently that in a large city a saving of at least 40 per cent. is effected by replacing horse cars with those propelled by electricity. Last September a committee of the American Street Railway Association reported as follows: "If it is desired to make a change from horse-power, electricity will fill the bill to perfection, no matter how long or short the road or how many passengers are carried. In the investigation of the subject the most satisfactory results have been shown; it not only increases the traffic over the road, but reduces expense, and actually enables us to operate at a profit a line which heretofore entailed a loss." With the improvements which will doubtless be brought out in the near future, the percentage of saving will probably be increased.

THE NEW YORK NAVAL MILITIA.

A few days ago the New York *Herald* published a long article describing the origin and growth of the State Naval Militia, and pointing out the claims of this body of naval volunteers for recognition by Congress. The First Battalion, New York State Naval Reserve Artillery, was formally organized in October last, and already counts a large muster-roll of members who show great energy and earnestness in acquiring the knowledge and training necessary to constitute them efficient defenders of our shores, should they ever be called upon to act in that capacity.

Company meetings are held every week, and a battalion meeting once a month, on which occasion a paper on seamanship or ordnance is read. Besides these meetings, company drills are held twice a week on board the U. S. ship "Minnesota," where the recruits are instructed in the use of heavy and machine guns. The attendance at meetings and drills is always very large, and the volunteers display great interest in all that appertains to the art of war.

We trust that such a patriotic and public spirited body as the State Naval Militia will obtain from Congress the ships they require in order to render their training more effective than it can be unless they have a ship of their own. It will be necessary for the guiding spirits of the battalion to arrange for the instruction of the recruits in electricity. During the last few years electricity has taken as prominent a place in the art of war as in the industrial arts, and this is perhaps more especially the case with naval warfare than with land operations. In the firing of guns, torpedoes and submarine mines, in hoisting shot and shell, in signaling orders between different parts of the ship, and at night from ship to ship, to say nothing of hosts of other more or less complex operations, electricity plays a part and a very important one.

Nowadays, the naval officer has to be an electrician as well as a sailor, and we trust that the directors of the State Naval Militia will recognize the fact early. It is a matter of common remark that the ranks of the electrical industry are largely recruited from those of the navy. Let us hope that electrical men will return the compliment by enrolling themselves among the members of the Naval Militia; such action could not but be productive of much benefit to all parties concerned.

DEPTFORD.

The attention of electrical engineers in England is just now centered on the progress of the London Electric Supply Corporation with their new central station, and no small amount of interest is also felt on this continent in Mr. Ferranti's gigantic experiment at Deptford, the London suburb.

Up to the present matters are not so satisfactory as could be wished, but entire confidence is expressed by the officers of the company in the ultimate success of the project. There are now working at the Deptford station two 30,000 light dynamos, but owing to the failure of the mains recently laid down to stand the pressure of 10,000 volts calculated for, the machines are running at a pressure of only 2,500 volts, or one-fourth of their normal capacity. Mr. Ferranti states in his report, however, that the manufacture of permanent trunk mains by the corporation's own staff is being vigorously pushed forward; these mains have been tested with excellent results but none have yet been put down. There are now being built two remarkably large dynamos of the capacity of 200,000 lights each. These machines will at first be used for 100,000 lights each, and it is expected that at the end of the present year the productive capacity of the station will be raised to 290,000 lights, which, allowing for the necessary reserve, will permit the supply of 160,000 lights simultaneously. Later, current for 200,000 additional lights can be obtained by simply adding the necessary engine power.

These are very tall figures, taller than any that we can show in this country, but all American electrical engineers will join us in wishing Mr. Ferranti success in his labors, and that dynamos and mains may realize his calculations.

The civilized world has lately had the opportunity of beholding two monumental examples of the skill and magnificent achievements of modern mechanical engineering in the Eiffel Tower and the Forth Bridge, and the electrical fraternity throughout the world will feel proud of the success of an electrical undertaking on a similar scale of bigness—a sort of electrical Eiffel Tower.

"URGENT" OR "DEFERRED."

Recently a Western Union telegraph messenger boy, 18 years of age, was arrested for opening a sealed envelope containing a message given him to deliver. The boy explained that he and all his companions were accustomed to open the telegrams in order to see if they were important, so that they might know whether to hurry in making the delivery or not.

Leaving aside for the moment the astonishing moral turpitude and amazing want of all sense of responsibility involved in such methods of executing their duty, it is a matter of speculation which telegrams the boys considered sufficiently urgent to be delivered at once, and which they deemed unimportant enough to be left until the contents of the current number of the *Boys of New York* or *Golden Hours* had been assimilated, or until the absorbing occupation of some game of skill or chance came to its legitimate conclusion.

A message informing a man of the death of his grandmother or of the baby's illness would be tossed aside as of very slight importance, one treating of mere arrivals or departures would meet the same fate, while a cipher message, concerning affairs of inestimable importance, would be treated with positive contempt.

It is easier, in this case, to pick out the goats than the sheep, and we can only call to mind one class of telegrams which any messenger boy would really consider urgent, and hurry to deliver at once, after having duly mastered the text; of course, we refer to messages concerning baseball and kindred topics.

Seriously speaking, there must be a very weak spot in the Western Union organization, if, as the boy in question alleges, the messengers are accustomed to constitute themselves judges as to which messages are "urgent" and which merely "deferred." The greatest amount of delay between the sending of a telegram and its receipt by the addressee often occurs during the last stage, after the message has left the receiving operator's hands, and if this delay is to be lengthened according to the judgment or inclinations of the messenger boy, a serious abuse of public confidence exists which should be checked at once.

CORRESPONDENCE.

Electrical Happenings in Washington, Boston, Philadelphia and Chicago.

OUR BOSTON LETTER.

An Electric Fire Alarm System has been introduced in Winsted, Conn.

An Electric Railway is to be constructed between Holyoke and Chicopee, Mass.

New England Telephone and Telegraph Company has protested to the aldermen of Waltham, Mass., on the stringing of electric light wires on the company's poles in the city named.

The Edison Phono Doll Company is very busy filling enormous orders to the trade in Boston, New York and other cities, which have been temporarily delayed.

The Amesbury Electric Light Company will soon supply the neighboring town of Merrimac, Mass., with arc and incandescent electric lights.

Chess by Telephone.—A game of chess was played between Messrs. A. B. Baldwin and John B. Weed, at Norwalk, Conn., April 17, the players using the telephone to direct their alternate moves, which were duly registered at their respective offices. The first named gentleman won on the 46th move.

An Electric Railway Franchise and a five year contract for lighting the streets of Greenfield, Mass., has been granted the local electric light company by the selectmen of the town named.

The Evans Friction Cone Company, of this city, has established a branch office at room 29, "Hathaway" Building, No. 620 Atlantic avenue.

Mr. E. C. North has been elected chairman of the electric light committee of the New England Insurance Exchange.

The Wainwright Manufacturing Company has sold one of its 400 horse-power heaters to the Easton, Pa., Electric Light Company, and another heater of the same make (150 horse power) to the Kewanee Electric Light Company, Kewanee, Ill.

Mr. H. H. Walter, general manager of the Card Electric Motor and Dynamo Company, Cincinnati, Ohio, was a welcome visitor at this office on last Tuesday.

Mr. W. J. Pilicy, of this city, has been appointed agent for New England of the Card Electric Motor and Dynamo Company, and New England representative of the Fidelity Carbon Manufacturing Company, of St. Louis. Mr. Pilicy's office is at No. 146 Franklin street.

Mr. L. H. Rogers, New England representative of the Brush Electric Company, has been appointed agent of the Short Electric Railway Company, of Cleveland, for the same territory. The interests of both the companies named will be carefully looked after in this section, notwithstanding the fact that Mr. Rogers will have to divide his time and attention between the enterprises named.

The Electric Mutual Insurance Company, of Boston, besides insuring electric light and power stations, and their respective equipments, will also accept risks on overhead wires and other outside apparatus (including lamps and fixtures) against damage by fire. Mr. S. E. Barton, the president has been appointed grand agent of several insurance companies, to write electrical property generally. Captain William Brophy, chief inspector for the company, will start in a few days on a three weeks' trip, to inspect electric light stations as far west as Kansas.

The Standard Thermometer Company, of Peabody, Mass., has found it necessary to increase its manufacturing facilities, and is now prospecting for an eligible site for a new factory at Salem, Mass. This well-known company manufactures several electrical specialties, including the celebrated Standard Telemeter.

Col. Louis W. Burnham, vice-president and manager of the Electric Gas Lighting Company, of this city, has returned from his long business trip in the Southern States. Col. Burnham reports the results arising from his trip as being highly satisfactory, and it will take several days to fill Southern orders for "Samson" batteries alone.

Thomson-Houston Electric Company held its annual meeting Monday, April 14th, at Middletown, Conn., and the stock was represented by fully three-fourths of the shares. Report of the company's treasurer was accepted by an unanimous vote. The entire board of directors were re-elected to serve for the ensuing year, viz.: Messrs. H. A. Pevear, C. A. Coffin, B. F. Spinney, C. H. Newhall, Elihu Thomson, S. A. Barton and J. N. Smith.

The Mather Electric Company, of Manchester, Conn., reports having closed, among several important contracts of recent date, an order for an isolated plant of 250 incandescent lights to be installed on a new steamer being built by the Goodrich Transportation Company, Chicago, and also an order for the installation of an isolated plant of 1,600 incandescent lights in the Davidson Theatre, Milwaukee, Wis., in connection with which will be used 10 arc lights of the Easton Electric Company's system.

Mr. Roswell P. Smith, of this city, for several years past identified with electrical interests in this section, now has charge of the Boston department of the Connecticut Motor Power Company, Plantsville, Conn. The popularity of Mr. Smith in this city, particularly among electrical and manufacturing industries, ensures for him a fair share of motor sales made at the "Hub." Mr. Smith's office is at No. 27 School street.

The Jarvis Engineering Company.—Business is active and satisfactory, as usual, with this old established and reliable house. Among its most important contracts of recent date are the following: An Armington & Sims engine of 50 horse-power for the new isolated electric light plant at the Boston Bijou Theatre; also two Armington & Sims engines of 100 horse-power each, and two Jarvis boilers for increasing the power capacity of the electric light station of the Charlestown, Mass., Gas Company; also one of the new type of Armington & Sims engine (compound condensing) of 300 horse-power, for the electric light plant of the Waltham, Mass., Gas Light Company. Manager J. N. Pratt informs me that his company "is in receipt of several orders for the new compound condensing engine manufactured by the Armington & Sims Company." This meritorious engine is gaining favor, as it becomes known, among the electric light people, and there is already a large demand for it; in fact, the Armington & Sims Company is taxing almost its entire manufacturing facilities to keep pace with orders for the new engine.

New England Wiring and Construction Company.—The new Exchange Building, now in course of construction on State street, Boston, is to be fitted throughout with a complete system of incandescent electric lights. This is one of the largest office buildings in the country, and the occupants will depend entirely upon electric light for artificial illumination, as no gas is to be introduced into the building. The contract for the wiring and appurtenances has recently been awarded to the New England Wiring and Construction Company, of Boston, the oldest house in this line of business in New England. The Interior conduit system will be used throughout for the wiring. This is the largest contract for work of this character which has been awarded in New England, and the largest with two or three exceptions in the country. The building will be wired for about 5,000 sixteen candle-power lamps.

Novel Use of the Phonograph.—At the regular monthly meeting of the American Folk Lore Society, April 18, in this city, a paper was read by Dr. J. Walter Fewkes on the "Phonograph in the Preservation of the Folk Lore of the American Indians." Dr. Fewkes, by indomitable energy and devotion to ancient history, has succeeded in recording by this instrument, for the edification of future generations, a number of songs, tales, legends and conversations of the Passamaquoddy Indians. These he ground out of the phonograph last Friday evening to the delight of a very large and appreciative audience.

Electric Stocks.—Boston quotations at closing hour of the Exchange, Saturday, April 19, were as follows:

Thomson-Houston Electric Company	56.
" " " " Preferred.	25¾.
" " " " Series C..	16¾.
" " " " Series D .	7⅝.
Thomson Electric Welding Co	.245.
" European Welding Co	.119.
Westinghouse Electric Co	42½.
Fort Wayne Electric Co	14½.
Edison Phonograph Doll Co	7¾.
TELEPHONE:	
American Bell	215¼.
Erie	40.
New England	49¾.
Mexican	.99
Tropical American	.80
National Tel. Mfg. Co. (acoustic)	.65

The Boston *Commercial Bulletin*, April 19, had the following to say on electric stocks:

European welding opened yesterday very strong and in the morning rose to 120. The stock is not active, but there seems to be considerable faith in its future. European welding opened Monday at 115, on Wednesday it had reached 117, and on Friday morning the stock had risen to 120. The figures show a gain of five points during the week, and a still further gain is probable. Fort Wayne has been more active this week than for some time. On Thursday the stock was traded in to a greater extent than any other electric stocks on the market.

The general market on the electrics for the week was strong but quiet. European welding is perhaps the most active and the most garnished with rumors and reports, which have been already treated in these columns. Thomson-Houston has been quiet, but the stock has retained its position, with but a slight decline.

Boston, April 19, 1890. W. I B.

New Orleans Telegraphic Tournament.

The fast telegraphic tournament at New Orleans was held Monday of this week. A special despatch to this office gives the result of the tournament as follows, the time being five minutes:

Class A—Won by W. S. Brewer, 211 words, superior Morse; —— Mentzer, 211 words, good; D. B. Jones, 210 words, good.

Class B—Won by T. G. Griffin, 194 words, superior Morse; J. G. Gordon, 187 words, fair.

Class C—P. A. Moake, 182 words, superior.

OUR WASHINGTON LETTER.

A Writ of Mandamus issued by the Supreme Court of the District of Columbia, on behalf of the United States Electric Lighting Company, of New York, requires the Commissioner of Patents to furnish a certified copy of the file-wrapper and contents of a divisional application filed December 15, 1880, by Thomas A. Edison, or satisfy the court why he should not do so. The bill of the United States Company, asking that the writ be issued, recites that, on May 2, 1885, the Edison Electric Light Company brought a bill in equity in the Circuit Court of the United States for the Southern District of New York against the United States Company for infringing Edison's patent, No. 223,898, dated January 27, 1880, relating to incandescent lamps. In that suit Professor Barker testified that this patent covers broadly all incandescent lamps with which he is acquainted. The United States Company believe that this construction of the patent is entirely beyond anything contemplated by Edison when the patent was issued, and includes very strong claims which were, at that time, rejected by the office and abandoned by Edison. It avers that the application which it desires to obtain was used by the Edison Company in the McKeesport suit and in other cases, and that it has been in extensive and notorious public use in all parts of the United States for nearly 10 years. The application for the mandamus declares that section 892 of the Revised Statutes, directing the Commissioner of Patents to furnish certified copies of any records, etc., "belonging to the Patent Office," gives them the right to the Edison application, and that the only papers which do not come within the province of this law are caveats. It further states that Patent Office Rule 15, which provides that "caveats and pending applications shall be preserved in secrecy," is inconsistent with the law and therefore void, as the Commissioner is limited to the making of rules which are not inconsistent with law.

The First Section of the Georgetown and Tenleytown Railway, two miles in length, has been completed, and the cars will be running regularly in a few days. The equipment of this road embraces all the newest and best features of the Thomson-Houston system. Messrs. Pierce and Duckett, representing that company, are on the ground to put the plant in operation, and that it will be a success goes without saying. Gen. R. C. Drum, the president of the railway company, has given his whole time to personal superintendence of the organization and construction of the road, and to his efforts its success is largely due. The road is double track, grooved steel rail, and the grade is the heaviest in the city, being as much as 8½ per cent. over part of the route. The power station is equipped with two Corliss engines, one of 250 horse-power, with a fly-wheel 16 feet in diameter, and weighing 16 tons, the other of 135 horse-power, with a fly-wheel 16 feet in diameter, and weighing 12 tons. Thirty-two inch and 25 inch leather belts transmit the power of the engines to a line of shafting on which are three pairs of fast and loose pulleys, 72 inches in diameter, which drive the dynamos. The three dynamos are 80 horse-power each, and are so arranged that they can be used separately, or in any desired combination. The cars are of Stephenson's make, and are provided with the regular 15 horse-power motors, two to each car. The brakes are of a special pattern, designed at Stephenson's.

The Local Electric Lighting Company and the other companies now operating electric wires, for any purpose, in the District of Columbia, have scored an important victory in the United States Senate by getting the committee on appropriations to strike out of the District bill a provision added to it by the House of Representatives, which was as follows: "The commissioners of the District may hereafter, under such reasonable conditions as they may prescribe, authorize any telegraph, telephone or electric light company, to lay wires under any street, alley, highway, footway or sidewalk in the District, whenever in their judgment the public interest may require the exercise of such authority, such privileges as may be granted hereunder to be revocable at the will of Congress without compensation, and this authority to continue only until the termination of the Fifty-first Congress." Under the present arrangement the commissioners have no authority to permit any new company to construct wires, and existing companies have an absolute monopoly of the business. If they can prevent the passage of pending bills granting charters and the right to lay wires, to proposed companies, the monopoly will be greatly strengthened and prolonged. G. C. M.

Washington, D. C., April 19.

OUR CHICAGO LETTER.

Marriage Bells.—Mr. Ernest L. Clark, western manager of the Walworth Manufacturing Company, of Boston, was united in marriage, on the 10th inst., to Miss Lillian R. Shaw, of Bloomington, Ill. The ceremony took place at the residence of the bride's parents. The newly wedded couple started to the northwest on their honeymoon, and upon their return will go housekeeping at 317 Forty-first street, Chicago.

W. B. Pearson, representative of the Ball Engine Company, of Erie, Pa., sold two 150 horse-power tandem compound engines to the Elgin City Railroad Company, Elgin, Ill.

Personal.—W. W. Low, salesman, Standard Carbon Company, was a recent visitor in the city.—Thos. Lowry, of Minneapolis, Minn., was registered at the Grand Pacific this week.—Geo. Atkinson was a recent visitor in the city.—W. C. Stewart, of St. Joe, Mo., spent a few days this week calling on his numerous friends in the city.

The National Engineering Bureau was incorporated under the laws of the State of Illinois, with the following officers: Geo. S. Baker, president; James A. Lounsbury, secretary, and Thos. G. Grier, treasurer. The company will occupy Room 331, "Rookery." The object of the company is the inspection of construction work, writing of specifications, and placing in the hands of bidders also a general mechanical and engineering business, with those who wish to build and equip plants. Mr. Grier and Mr. Lounsbury will act as engineers for the company.

Thos. Wolfe, southwestern agent of the National Electric Manufacturing Company, reports the following sales for this month: Coffeeville, Kan., 500 alternating incandescent lights; Oklahoma City, 750 alternating and 25 arc lights; Long Bros., Kansas City, Mo., 400 direct incandescent and 15 arc lights; Abernethy Furniture Company, Kansas City, 150 direct incandescent.

J. A. Grant & Co, agents of the McKintosh and Seymour engine, have closed a contract to install engines aggregating 600 horse-power in the new depot of the Wisconsin Central Railroad Company, in this city.

The Funeral of H. A. Glasier was held at his late residence, 3026 Pramier avenue, on Friday morning at 10.30, and was largely attended by friends and members of the Electric Club. The following gentlemen acting as bearers: C. C. Haskins, Geo. Cutter, Mr. Walker, Mr. Martin, Mr. Beach, W. A. Kreidler, Fred. DeLand and Alex. Kempt.

R. T. McDonald, of the Fort Wayne Electric Company, arrived in the city to-day for a short visit.

C. E. Gregory, of the Sperry Electric Company, is hard at work preparing a new catalogue, which the company will soon send to the trade.

The Excelsior Electric Company remove May 1st, from their present quarters on Adams to 425 Rookery building.

Ernest Hoefer has secured the western agency of the Trinidad insulated wire.

The Phœnix Boiler Company have closed a contract to furnish 225 horse-power in boilers and same capacity in engines, to Hannon & Hogg, to be used in their new building. The contract for the electric plant has not been given.

G. A. E. Kohler has been appointed manager of the western office of the Eddy Electric Manufacturing Company, and has opened an office at 329 Rookery. D. B. D.

April 19, 1890.

OUR PHILADELPHIA LETTER.

Personal.—Gen. C. H. Barney, of the Sawyer-Man Company, attended the anniversary meeting of the Loyal Legion, held during the past week.—Col. C. M. Ransom, of *Modern Light and Heat*, made a short stop in the city recently.

Conduits.—Considerable work in laying conduits of creosoted wood is contemplated for this spring.

The Thackara Manufacturing Company have beautiful quarters at 1524 and 1526 Chestnut street. This firm is prepared to do general construction work, and have organized a department for that purpose. On the second floor of their building is a large apartment especially fitted up to show electric fixtures. A large number of new and beautiful designs are already in stock and more are being made. Among the buildings in this city which the Thackara Company have wired and fitted up are the Masonic Temple, Union League Club house, and the Y. M. C. A. building.

The Chester Foundry and Machine Works, of Chester, are building a number of heavy compound engines for driving generators in street railway work. The sizes run from 300 to 900 horse-power, and are built both tandem and side by side compound.

The Gibson Gas Fixture Works, 1426 Callowhill street, report business very brisk, indeed. This is the firm which refused to join the "trust" and which has stuck to its determination to sell exclusively to dealers. Six years ago, when the company was organized with this purpose in view, failure was predicted, or, at least, a change in ideas, but the uniform success which they have achieved has proved these predictions fallacious. S. L. C.

Philadelphia, April 19, 1890.

Telephonic News

⁂ Telephone wires in Hartford, Conn., are to go underground.

⁂ The whole telephone system in Augusta, Ga., is to get a general overhauling, and the line is to be rebuilt to the Locks.

⁂ "We have men here," says a Cincinnati paper, "who wouldn't believe in the telephone, until they were called up and dunned for an old debt over the wire."

⁂ Two Japanese officials, now on their way home from Berlin, will open the first telephone line in Japan. It will connect Striznoka and Yokohama, which are 100 miles apart.

⁂ Mr. Chas. E. McCleur, the well-known superintendent of the Southern Bell Telephone Company, with headquarters at Richmond, Va., is the inventor of a telephone toll box and connection register. This was recently announced as "tool" box, but the invention relates to telephone tolls, not tools.

⁂ The Southern New England Telephone Company have begun the work of excavating for the new underground system of wires which is to be used in Hartford, Conn. The line of subways in contemplation is something over two miles in length, and from 50 to 200 feet can be laid in a day. It is expected that the work will be completed in about six weeks.

⁂ Governor and council have assessed the following taxes against the telegraph and telephone companies of Maine, the rate being 2½ per cent.: New England Telephone and Telegraph Company, $1,650; Western Union Telegraph Company, $3,125; Maine Telegraph Company, $1,250; Great Northwestern, $125; Eastern Telegraph Company, $450; International Telegraph Company, $1,250.

⁂ In regard to town telephone wires, it is worthy of remark that notwithstanding the violence of several of the storms in the towns having a telephone system, the accidents from lightning, compared with former years, as shown by figures gathered at Berlin, are strikingly few, and the assumption does not, therefore, appear to be without justification that the wires stretched over the roofs afford effective protection in equalizing atmospheric electricity.

⁂ The World Telegraphone Company, with a capital stock of $500,000, in $100 shares, is a Washington, D. C., company, organized under West Virginia laws and based on an invention of Malone Wheless, which is intended to provide means of automatically recording a telephonic communication when the person to whom the communication is addressed is not at the instrument. Henry M. Baker, No. 1411 F street, is the president of the company.

⁂ The Telephone Exchange, Cincinnati, was badly damaged by one of the electric railway wires coming in contact with a number of the telephone wires. A heavy wagon ran against a telephone pole, breaking it down, and the network of wires fell across an unguarded trolley wire of the electric railway company, and the strong current partially burned out the switchboard in the central station. Mr. William Beesan, superintendent of the company, estimated the damage to the switchboard at about $5,000.

⁂ A suit was brought in United States Circuit Court in Boston, January 11, by the Western Union Telegraph Company, against the American Bell Telephone Company, charging infringement of contract existing between both companys. The suit is in nature of bill in equity seeking to have the court continue certain portions of the contract. The question has grown out of the introduction of the long distance telephone service. The defendants filed an answer on March 31. The result of the suit, whatever it may be, will have no material effect on the long distance service.

GREAT TELEPHONE WORK.

EXHIBIT OF THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY AT THE LENOX LYCEUM, NEW YORK CITY.

In order that the public may become familiar with telephone service as given by the American Telephone and Telegraph Company, there has been placed in the Lenox Lyceum, New York, five standard cabinet booths, containing the long distance cabinet set. By means of this arrangement the public can, without expense, call up their friends in any part of the country to which the lines of this company operate, including, among others, the cities of Buffalo, Albany, Boston, Providence, Hartford, Springfield, Philadelphia, Washington and Baltimore.

Entering the passageway leading to this company's exhibit at the Lyceum, one finds,

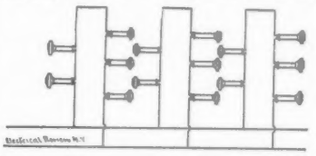


FIG. 2.—TELEPHONES IN SERIES OF FIVE.

at the left, a room 18 feet square, where the loud speaking telephone is exhibited. In this room is heard a cornet solo and talking from Boston, Mass. It is possible to hear ordinary conversation in this room in all portions, the loud effect being produced by attaching a trumpet to a regular Bell telephone.

At intervals of 15 minutes, a cornet solo was played at No. 127 Purchase street, Boston, Mass., and listened to by all of the people in this room, one evening last week, it apparently making no difference in the volume of sound whether they were within one foot or 10 feet of the instrument.

Mr. E. H. Lyons, at Boston, Mass., followed the cornet solo with numerous recitals, such as "the Charge of the Light Brigade," "Sheridan's Ride," "Barbara Fritchie," and "The Barefoot Boy," all of which were distinctly heard. When it is considered that this transmission is over a circuit 258 miles long, consisting of 516 miles of wire, we are safe in saying that such transmission has never before been equaled.

On leaving the loud speaking room, one sees immediately before him a regular long distance metallic circuit switchboard, such as is used in the smaller offices of the American Telephone and Telegraph Company. Connected with this switchboard are 10 metallic circuits extending to Boston, Syracuse, Philadelphia and the Cortlandt street exchanges, by means of which connection may be had with any portion of the company's plant.

Also connected with this switchboard are 200 Bell telephones of the smaller pattern called police receivers. These receivers are located on a double rack suitably covered with plush. In order to insure perfect connection with each one of these telephones, all connections are soldered and wired with Okonite wire. The receivers are grouped in five groups, four groups of 40 each, arranged in multiple series of five as shown in diagram, Fig. 2. These groups are used for transmission from the theatres. Another group consisting of 39 receivers are arranged in multiple series of three, this group being used for long distance connections. The secondary circuits of the induction coils are connected with the line wire in multiple arc, this having thus far proved to be the most advantageous arrangement. Two transmitters are operated from the same battery. It has been found that the Fuller battery gives the best results in this work.

Every evening, commencing at 8 o'clock, connection is made with the Casino and Broadway Theatre. The arrangement of the transmitters at the Casino is shown in Fig. 3. These transmitters are of special construction and are arranged for theatre work, nine being used in front of the boxes and gallery.

Difficulty has been experienced in handling the great crowds of people who throng about these telephones during the hours the Lyceum is open. It seems as though a person obtaining a position at the telephone wishes to remain there the whole evening, evidently knowing a good thing when he or she hears it. It has been suggested by some electrical cranks, that it might be advisable

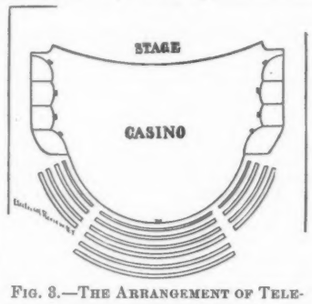


FIG. 3.—THE ARRANGEMENT OF TELEPHONES AT THE "CASINO."

to turn a pole changer on the circuit, thus absolutely driving the people out of the room.

The arrangement outlined at the Casino has been applied at the Broadway Theatre, and during the past week the theatre music has been transmitted to newspaper men at Syracuse and Boston.

It is expected that early this week the Lenox Lyceum will be in direct communication with Philadelphia, whereby people in New York may hear Pauline Hall at the Chestnut Street Theatre.

A number of visitors have taken advantage of the facilities provided for talking to different cities. Last week a lady entered one of the booths, and wished to talk to Philadelphia. Having obtained the Philadelphia central office, she called for John Wanamaker's. To the young man who answered, she said that about a year and a half ago she had purchased at Wanamaker's ten yards of black camel's hair cloth, and would like to know if any of that lot remained in stock, and the young man answered that he would look it up. But after patiently waiting about ten minutes, she left the telephone; evidently the stock, like her patience, had given out.

In addition to the cornet and speech transmission from Boston, an Edison phonograph is connected, and the music transmitted from this instrument may be distinctly heard by the people listening at the telephones at the Lyceum. It has been observed that the scratchy quality, sometimes noticed in the phonograph, is entirely obliterated by transmission through a telephone over a line 250 miles long.

The arrangement of the receivers in multiple series of five bring the total resistance down to 87 ohms (the resistance of the ordinary hand telephone), the line resistance in addition between New York and Boston being 2,500 ohms. Were all the receivers in a single series the resistance of the 40 instruments alone would be 5,600 ohms, making a total instrument and line resistance between New York and Boston of 8,100 ohms, plus the instrument resistance at the Boston end. The very excellent idea of setting up the instruments in multiple series, of five proves to be a very advantageous one, credit for which belongs to Electrician F. A. Pickernell.

It is not out of place to mention here that this very interesting and important exhibit reflects great credit on the entire management of the American Telephone and Telegraph Co. Mr. A. S. Hibbard, general superintendent of the company, has been indefatigable in his efforts in making the exhibit a thoroughly representative and modern one, and in this work has been most ably assisted by Mr. F. A. Pickernell, F. J. Hovey and their assistants, Messrs. A. S. Williams and H. J. McCartney.

It is interesting to see how the long distance wires, which are so busy throughout the day handling the most important business transactions of the Eastern States, are at this exhibit each evening utilized for the entertainment of the crowds present at the Lyceum, making available the talent of a hundred cities. This wonderful result so well described by Bellamy is, before his book has been published a year, no longer a possibility of the future, but an accomplished fact of the present.

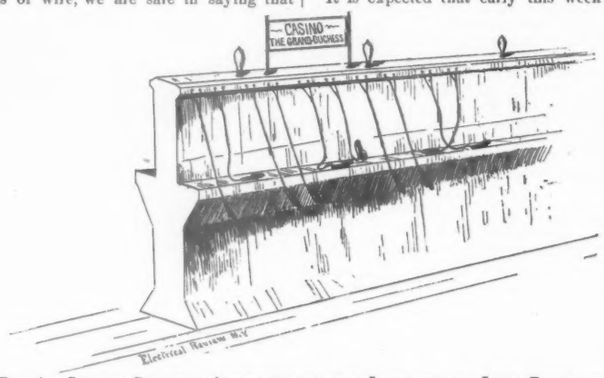


FIG. 1.—SKETCH SHOWING ARRANGEMENT FOR LISTENING TO LONG DISTANCE TELEPHONE WORK AT THE LENOX LYCEUM, N. Y.

Telephone Rates in New York City.

Mr. Charles F. Cutler, president of the Metropolitan Telephone and Telegraph Company, of New York city, recently argued before the Assembly Committee on Gas and Electricity against the bill of Mr. Clarke, of New York, which fixes the limit of regular telephone charges in this city at $84 per year. Mr. Cutler talked on the subject of telephone service in New York, claiming that it could not profitably be rendered for less than the present price, $150 per year. For this sum subscribers were afforded the privilege of talking with 8,000 people, a greater number than any other telephone exchange in the world could boast. New York city had more telephones than France, and New York and Brooklyn had more than Great Britain. In London the price was $100 a year for service which New Yorkers would not tolerate. The cost of operating telephones in London was not more than 50 per cent. of that of the New York service, so the comparison between New York and London was manifestly unfair. The true basis on which telephone rates should be considered was the value of the service to subscribers. "I do not believe," said Mr. Cutler, "that the big business men of New York city are in sympathy with this movement to reduce telephone rates. They desire the quickest and best service possible, and are willing to pay for it. The expense of employés alone costs us over $40 for each subscriber. We employ over 800 persons at an annual expense of over $500,000. To-day the business will not pay 7½ per cent. on the capital stock. There have been numerous unsuccessful attempts in various States to secure legislation of the kind now proposed. In Indiana the rate was reduced several years ago, with the result that the telephone service was practically ruined." Mr. Cutler invited the members of the committee to visit New York and examine the workings of the present system, promising to give them every opportunity to judge for themselves whether the price paid by subscribers is more than the expense of maintenance demands—a good opportunity for the legislators to receive some much needed information.

A Change on the Part of a Telephone Man.

W. S. Kepley, a member of John I. Sabin's staff, a toiler on behalf of the Sunset Telephone-Telegraph Company, San Francisco, has tendered his resignation and severed his connection with $2.50 a day, which came to him from the treasury of said company, to join the Salvation Army. This change was made March 31st and is being kept very quiet by the officers of the telephone company, as it is particularly embarrassing to the vice-president and general manager, John I. Sabin It is taken by all his friends as an indication that the wickedness of the business so preyed upon the said lineman's mind, that he was compelled to make this change hoping for better things in the hereafter. Col. Sabin, however, endeavors to contradict this impression by calling attention to the fact that the telephone business is of such a philosophical and religious nature, and that all his staff are men of such excellent deportment, that theologians and Salvation Army men can be supplied on a moment's notice from any department, with a possible exception of the general manager himself or Director Louis Glass.

Mr. Kepley, the retiring lineman, is succeeded by William Pape, and the work of the telephone company still goes on, as it is to be hoped does the work of the Salvation Army, assisted by the telephone recruit.

We have private information to the effect that Col. Sabin would rather give us $100 than publish this matter, for he does not want to appear to be in charge of a training school for the Salvation Army, but we must publish the news regardless of our own feelings in the matter.

Mexican Telephone Company.

At the annual meeting of the Mexican Telephone Company, in New York, last week, the old officers and board of directors were unanimously re-elected. Nearly 100,000 out of 168,000 shares outstanding were represented. The figures of operations for the year ended March 31, make the following comparisons:

Year, March 31.	1889-90.	1888-89.	Increase.
Gross receipts	$68,190	$57,954	$10,236
Expense and construction	39,370	43,428	*4,058
Net	$28,820	$14,526	$14,294

*Decrease.

The instrument output was increased by 138 telephones, of which 100 were in the city of Mexico. The construction account showed a large increase, which in the city of Mexico increased $6,000. The five substations showed increases in the construction account, varying, from $550 to $2,000. During the year $8,000 of old indebtedness left by former managements was paid. These are the directors: Robert Colgate and Orrando P. Dexter, New York; Maurice L. Guiraud, Mexico; W. French Smith, W. H. Harrington and John D. Sargent, Boston, and Herman Hall, Sangus, Mass.

Telephone Service—Mandamus.

The Supreme Court of Indiana held, in the recent case of the Central Union Telegraph Company *vs.* The State *ex rel.* Hopper *et al.*, that, under the laws of Indiana, a person desiring telephonic service by means of instruments placed in his place of business and connected with a central exchange, where such exchange is maintained, can compel by mandate the furnishing of such service, and that it is no defense to say that the person or corporation engaged in furnishing telephonic service does not rent telephones, but furnishes such service by means of public toll stations.

The North East Street Railway, of Kansas City.

The subject of the accompanying illustration is the North East Street Railway, of Kansas City, Mo., which has been in operation since March 5, 1889. The road is 3.45 miles in length, and contains 10 double track curves of a radius of 35 feet, besides numerous grades, the highest of which is 8½ per cent. The track is laid with 45 lbs. girder rail. The overhead cross suspension construction is used throughout the entire length of the line. The electrical equipment consists of three 80 horse-power Thomson-Houston generators, with suitable switchboard and appliances. At present six cars are in daily use, and others will soon be added. The operation of the road, since its start, has been most successful in every particular.

ELECTRIC RAILWAY AT KANSAS CITY.

Delany's Speed Indicator.

TO THE EDITOR OF ELECTRICAL REVIEW:

Please state in the REVIEW that the readings of my speed indicator at the fast sending tournament were erroneous. The instrument was put together but a few minutes before the trial commenced, and was not properly regulated. In each result given, the impulses are considerably in excess of the actual number. The indicator is now in order, and will work at a speed of 30 impulses per second for hours at a time, without a single error. PATRICK B. DELANY.

New York, April 15, 1890.

Phonograph in Washington.

Last week, at Washington, seven Senators sent congratulations and complimentary messages to Henry M. Stanley through Col. Gouraud, Edison's European partner. The messages were spoken in the phonograph and will be repeated to Stanley at a dinner to be given him by Col. Gouraud on his arrival at Paris. Col. Gouraud, by request of President Harrison, reproduced at the White House, in the presence of the President, Mr. Andrew Carnegie, Mr. William Garrison and Private Secretary Halford, Mr. Gladstone's message recently sent to New York.

Battery Experiments.

The students of the Columbia College School of Electricity have just finished the construction, for experimental purposes in the laboratory, of a battery of 1,280 cells, which, when set up with Daniell elements, gives an E. M. F. of about 1,400 volts, and when set up as a storage battery, an E. M. F. of about 2,800 volts. Some interesting results have been obtained from the experiments performed with this battery.

Electrical Equipment of the Steamship "Majestic."

The elegant new White Star Liner, the "Majestic," which broke the record for maiden trips, was crowded with visitors during her short stay in New York, last week. Not the least interesting feature of this greyhound of the ocean, is her electrical equipment. Four Crompton dynamos, of 400 lights capacity each, furnish current for the incandescent lighting system of the vessel. The dynamos are coupled directly to Tangye compound engines, built in Glasgow, and run at 170 revolutions. The system of wiring is novel, the lamps all being run on a single wire, the ship itself serving as a return. Only 1,000 lamps are in use, though the dynamos can supply 1,600 with current. The lamps are of two sizes, 16 and 50 candle-power. Two lamps of 50 candle-power each are used in each of the side lights. On the bridge is a 12,000 candle-power projector, which is designed for use when the vessel is in service as a government cruiser.

In the barber shop a little motor runs the hair brushes. The electroliers and fixtures are not quite up to the American ideas of such things, but are of a practicable and serviceable design. No attempt is made at novel lighting effects, such as are in use on the Fall River steamers, but the prime object of getting light is accomplished.

Another Storage Battery.

Sidney H. Barrett, of Springfield, Mass., has just invented a new form of storage battery. After months of investigation, he claims to have succeeded in making a combination of the usual leaden plates of the storage battery, by which the active material is caged so as to prevent the falling out which, it is said, happens with the present form of storage battery after a short term of service. The arrangement of the plates is also such as to prevent the twisting and bending, which was also a serious drawback, and the new cell of the same efficiency as the Julien cell, which is the lightest and most compact now on the market, occupies but half the space and weighs but half as much. The complete cell weighs 18 pounds and is composed of nine compound plates, each 6 by 4½ inches in size, the capacity being 125 ampere hours.

TELEGRAPHIC.

.... The Postal-Telegraph Cable Company (Mackay-Bennett) have established an office at Charleston, S. C. Mr. M. S. Harris is the manager, formerly the manager of the Postal-Telegraph office at Columbia, S. C.

.... In the Sikkim expedition a telegraph office was opened which enjoys the distinction of being the highest in the world. It is situated at Bhutong, at an altitude of 13,500 feet, nearly 2¾ miles, above the level of the sea.

.... The semi-annual meeting of the directors of the Commercial Union Telegraph Company was held in Albany, last week. A semi-annual dividend of five per cent. was declared. The company has decided to build a second line from Boston to Portland, Me., by way of the Boston and Maine railroad, and from Portland to Rockland, Me., along the lines of the Knox and Lincoln roads.

.... The Western Union Telegraph Company will connect Denver and Salt Lake with an additional No. 8 wire. The material is now at Milford for two new wires to Pioche, two new wires are being strung along the Union Pacific south of this city, and a new wire is being put up between Omaha and Salt Lake City. There will be five new wires in the Salt Lake office within the next five months.

.... The Attorney General of Massachusetts, *ex rel*, *vs.* The Western Union Telegraph Company. This was an action to recover taxes assessed upon the defendant's property in Massachusetts. The case resulted in favor of the plaintiff, and the defendant paid money into court upon order. The plaintiff now claims that interest should be paid upon that. The court upon hearing enters the following rescript: "Under the 30th law rule of this court and the several cases cited by the counsel for the defendant, I am clearly of opinion that the payment into court under the order of the court by the defendant of the sum of $10,956.49 on June 8, 1888, should be treated as a settlement *pro tanto* of the plaintiff's claim, and that the interest upon the amount ceased from that date."

.... The pool rooms of this city, and the country at large, are going to have a lively time of it for the next few weeks if the New Jersey Jockey Club authorities adhere to their present stand in regard to telegraph facilities at their Elizabeth course. It will be remembered that there was no telegraph communication between Monmouth Park and the outside world for some time last season. The object of this was to compel persons who wanted to bet on the races to visit the track, and also to protect the interests of the bookmakers, who paid a liberal sum for the purpose of making books at the track. The situation, to-day, is practically the same, and the hundreds of pool rooms will be unable to do any business if they cannot receive returns of the different events from their correspondents at the tracks. The Western Union Telegraph Company are fertile in schemes, and they may be able to circumvent the Jockey Club, and receive the returns despite the ukase. The bookmakers who have engaged booking privileges at Elizabeth will certainly favor the change, while the keepers of the city rooms will declare the movement autocratic and tyrannical.

Who Knows Where It Is?

It is said that the original telegraph instrument used by Professor Morse, at Washington, to send the first message ever transmitted by his system, was not destroyed, as has been currently reported, but that it was in Morse's possession a very short time before his death. If it is still in existence it should be deposited in the National Museum by the side of the companion instrument used by Mr. Vail, for which the owner is trying to get $10,000, or sent to the museum of the New York Electric Club.

* * The Salem, Mass., Tabernacle Church has introduced electricity as a motive power for blowing the organ.

* * The Springfield, Mass., Street Railway Company will shortly commence the work of extending its tracks. The introduction of the electric system is part of the company's plan, and the Thomson-Houston system is to be used.

* * In addition to its 100 horse-power engine, the Leicester, Mass., Electric Company intends putting in a 40 horse-power water wheel to run the dynamos. The engine hereafter will be used only when there is not sufficient water-power.

* * Further trials of the new electric submarine torpedo boat "Goubet," which is named after its inventor, have been had at Cherbourg, France. The boat was submerged for three-quarters of an hour, and during that time performed a number of manœuvres which satisfactorily proved that she can be handled with perfect ease and safety under water.

* * The Rio Grande and Eagle Pass Railway Company are determined, as soon as their mines, 20 miles above Laredo, Texas, are worked by electricity, to furnish the manufacturing enterprises of Laredo with as cheap coal as any other point in the United States.

* * The city government has granted an exclusive franchise to the Consolidated Light and Power Company, of Dover, N. H., to erect poles and wires for a term of 10 years, and the Union Street Railroad between Great Falls and Dover will be begun at once. It is to be completed before July 1st.

* * The Electric Generator Company has been organized at Portland, Me., with a capital stock of $1,000,000. President, E. H. Hyde, Jr., of Hartford, Conn.; treasurer, Earnest Cady, also of Hartford. Business to be prosecuted, manufacturing and dealing in generators and electric appliances.

* * Work is progressing quite rapidly on the power plant of the Belt Line Railroad Company, Utica, N. Y. The four boilers are set, and the boiler house is about complete. The engine room is being floored, and one of the engines is being placed in position. Parts of dynamos have arrived.

* * It is proposed to construct an electric railway between St. Petersburg and Archangel, bridging the wide stretch of 500 miles between the Baltic and White Seas. It is intended to erect stations along the line for generating electric currents. The enterprise is backed by ample capital at Archangel.

* * The Wheless system of electric railway is making headway at Washington. Frequent experimental trips of the car is being made on a half mile track, with exceedingly heavy grades and sharp curves. This track is located near the Eckington power house, from which the current is supplied. The car is equipped with Thomson-Houston motors. Mr. Wheless has made several alterations in his original plan, as heretofore described in the REVIEW, and has various other devices to try.

* * Specifications for the building of a large dam in the Colorado River, to utilize the water power for electric light works, etc., at Austin, Tex., have just been submitted. The estimates call for a 60 feet dam with crest 1,150 feet long, 16 feet wide at the top, and 50 feet at the base, to have a mean capacity for 5,227 horse-power, day and night, and proposes that three water wheels of 600 horse-power each be put in. The construction of a reservoir with capacity for 37,000,000 gallons of water is urged. The estimated cost, including construction of dam and reservoir, gate house, pumping and electric plants, mains, etc., is $1,370,000. The issuance of $1,500,000 of bonds for the work is contemplated.

* * In a recent comparison of the cost and running expenses of electric railway and horse roads, the estimate takes into consideration the running of 50 cars by electricity and horses. The 250 horse-power steam engine and three 100 horse-power boilers are estimated to cost $7,200. Other expenses connected with them are placed at $2,500. The cost of the dynamos or generators is counted at $14,400, the motors for the cars at $20,000, the station house at $5,000, and the electric conductors at $10,000. The original cost of the motive power for the horse cars is estimated as follows: 425 horses at $125 each, $53,125; 100 sets of harness, $500; stable for horses, $20,000. The total original cost of the motive power for the electric cars would, therefore, be, $59,100, and that of the horse equipment would be, $73,625. The cost of running per day of 16 hours, about the average street car day, is reckoned as follows:

ELECTRIC ROAD.		HORSE ROAD.	
Coal	$20 00	Feed for horses	$191 25
Engineer	6 00	25 stablemen	37 50
Firemen	4 00	12 other stable employés	18 00
Machine men	4 00	Horse shoeing	21 00
Oil, waste, etc.	2 50	Veterinary surgeon and medicine	2 00
Interest 6 per cent., and depreciation 10 per cent.	32 00	Interest 6 per cent., and depreciation 15 per cent	34 00
Total	$68 50	Total	$303 75

A little computation on the foregoing estimates, will therefore show that the cost of running an electric car a day, is $1 37, and of each horse car, $6 07.

The State Senate Committee Investigates.

During the present investigation the committee will inquire into the method of running electric cars, the use of motors, the system of steam heating and gas mains and their effect on subways.

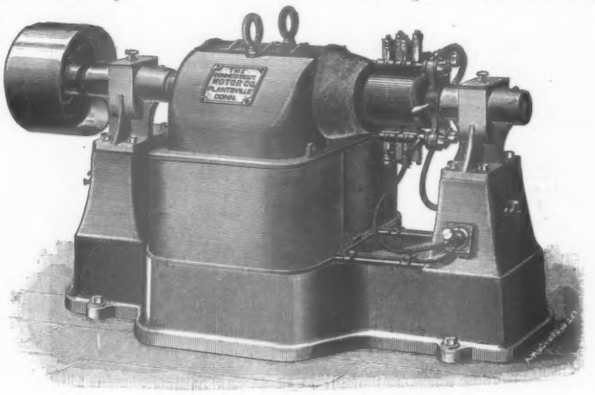


FIG. 1.

Senator Coggeshall believes that subway explosions are caused more by improperly constructed gas mains than from any other cause.

Mr. F. J. Sprague testified at length concerning electric railways.

Superintendent McCormick, of the Lamp and Gas Department, D. P. W., has testified that explosions were the result of several causes, principally from street workmen injuring the mains.

He said that in this city there were upwards of 1,200 miles of gas mains, there being 1,123 miles on Manhattan Island alone. The Consolidated, Mutual, Equitable and Standard Companies conducted the business below the Harlem river; above the business was controlled by the Central, Northern and Yonkers. The capital stock of all amounted to $17,737,400.

Thomson-Houston.

The Thomson-Houston brief annual report issued recently to stockholders shows a splendid business. Besides the $1,000,000 given to stockholders the past year, the company is said to show a good deal more than a million carried to surplus account. The aggregate sales in 1889 were $8,000,000 against $6,000,000 in 1888, and $9,000,000 in 1887. It is stated as not improbable that the Thomson-Houston Company is now earning at the rate of $3,000,000 net per annum.

The Connecticut Motor.

The accompanying illustrations represent the large and small stationary electric motors manufactured by the Connecticut Motor Company, Plantsville, Conn.

Fig. 1 shows the larger type of machine which the above named company manufacture in sizes ranging from seven to 50 horse-power.

The small machine, as shown in Fig. 2, differs in form in several respects to the one represented in Fig. 1. The smaller type of motor is manufactured in sizes from one-half to five horse-power. It is compact in form, and requires very little floor space, and is so constructed that it may be fastened to the

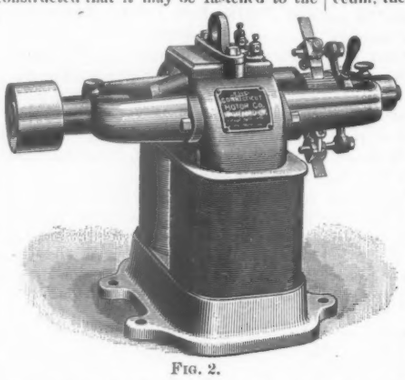


FIG. 2.

ceiling—"upside down"—and will work just as well in that position as in any other.

Both types of the Connecticut motor are attractive in appearance, and, on close inspection, show that in detail of construction, both electrical and mechanical, the motor is of the highest order.

The field magnets are one solid casting of soft iron, without joints, giving an extremely strong field at the expense of very little electrical energy. The shafts are large and made of the best of crucible steel, and the bearings are of ample capacity, made from the best of gun metal. The company's new self-lubricating boxes are connected with shafts and bearings.

The armatures and fields are carefully wound and thoroughly tested. The armature conductors are of large capacity and give close regulation to speed, which in this motor is comparatively low. The brushes used in connection with an improved commutator prevents sparking. All parts of the motor are made to gauge and are interchangeable.

The officers of this company are: Robert E. Dunston, president; Charles D. Smith, secretary and treasurer; and directors are Messrs. R. E. Dunston, E. W. Twichell, E. J. Neale, C. D. Smith and C. C. Sterling.

A Final Telephone Dividend.

The Continental Telephone Company has declared a final dividend of $10 per share in liquidation to stockholders surrendering certificates on or before April 26. The corporation will be dissolved. The Tropical American Telephone Company is the successor and assignee of this company in South America and Central America and the West Indies, and is developing that field rapidly. Each Continental shareholder received five shares of Tropical stock as a dividend some time ago.

A Peep into the Twentieth Century.

A special invitation was sent out by Mr. A. B. De Frece, the gentleman who is covering himself with honor in his management of the Lenox Lyceum exhibition, in which he invited the members of the New York press, daily and technical, to be present at the Lyceum Friday evening, on the occasion of the rehearsal of a play entitled "A Glimpse of the Twentieth Century." The author is Mr. M. J. Sullivan, who also appeared as "Ray Clemens" in the cast, the other performer, "Jack Wetmore," being Mr. F. X. Blake. The rehearsal was given on the stage in the basement of the Lenox Lyceum, the curtain rising on the scene where "Jack Wetmore" has just been awakened from a 100 years' trance. A number of very interesting and surprising things were shown the awakened one, and it becomes evident that electricity is the leading element in all. Low pressure electricity, it was stated, is used for domestic purposes; high pressure for defense. Traveling through the air and with lightning speed across the water, were two of the improvements that astonished the nineteenth century visitor. By means of the telephone they were able to connect with all parts of the world, and also see what was occurring in different parts of the globe. The statue of John L. Sullivan is shown on top of Bunker Hill monument, and that of Ward McAllister in Madison Square, on George Washington's horse. The piece concludes with the departure of Wetmore for Europe, a two hours' journey, to find the great granddaughter of the girl he loved 100 years ago, her face having been seen by him by means of the telephone.

This "glimpse" is to be given publicly in the exhibition for a few weeks.

A newspaper called *Events*, published in the year 1999, is full of interesting matter very much condensed, and gives the events that are supposed to be occurring at that time. It is to be noticed, however, that it is copyrighted by the genial manager, Mr. A. B. DeFrece, in the year 1890. Its price is $2.50 per year, delivered daily by means of an electric tube. *Events* is a very interesting little paper and full of a number of bright things.

OBITUARY.

Mr. C. W. Jenks, father of the well-known electrical expert, Mr. Wm. J. Jenks, died at Nyack, N. Y., on Thursday, April 17th.

Mr. H. A. Glasier, of Chicago, who was for many years identified with the Jarvis Engineering Company, of Boston, died at his home April 17th suddenly, of valvular disease of the heart. Mr. Glasier had recently become associated with the Messrs. J. A. Grant & Company, of Boston, as western agent, and at the time of his death was busily engaged establishing the firm's western office.

Benjamin F. Sturtevant, the widely known inventor and manufacturer, died at his residence in Jamaica Plain, Mass., last week. In 1884 Mr. Sturtevant turned his attention to the building of blowers, and invented the blowers and exhausting fans which bear his name. In 1878 he commenced the building of his works at Jamaica Plain, the largest of the kind in the world and one of the most extensive industries in New England. On completion of the new factory Mr. Sturtevant added to his varied interests another important feature, that of steam engine manufacture. This enterprise also prospered from the start, and for several years there has been a steady and growing demand for the Sturtevant engine. Mr. Sturtevant built Sturtevant Hall, at the Newton Theological Institution, and contributed largely to the Dedham Home and the Home for Little Wanderers. His gifts for philanthropic work during his life aggregated $250,000.

It is said that Chicago is to have an Eiffel tower 500 feet higher than the one at Paris; that M. Eiffel is to construct it, and that Mr. Edison will illuminate it with 1,000,000 incandescent lamps.

The New England Electric Exchange.

The second annual meeting of this progressive and useful association was held at the rooms of the Boston Electric Club, No. 7 Park street, Monday afternoon, April 14th. President P. H. Alexander presided and in his yearly address traced the growth of the Exchange from its inception, and alluded to the work it had accomplished in the field of electricity. The financial success of the organization, he said, is assured. The successful work of the Exchange can be shown by the fact that insurance underwriters are thinking seriously of discontinuing inspections of electric light plants. Two years ago the insurance interests and the Exchange were antagonistic, to-day the insurance companies say: "Obtain a license from the New England Electric Exchange and we will feel certain that no further inspection is needed from us."

The president's address was followed by the reports of the secretary and treasurer. By the former it was shown that the present membership is 93, while the latter report gave the receipts of the year as $851, expenditures, $667, and the cash on hand, $183. By the license statement it appeared there had been 354 applications for license, all of which had been granted after due examination. Officers for the ensuing year were elected as follows: President, Alexander P. Wright; secretary and treasurer, H. H. Fairbanks, of Worcester; directors, E. H. Hewins, H. C. Spaulding and W. S. Hill. The new president is the manager and director of the Wright Electrical Engineering Company, of Boston.

OUR ALBANY LETTER.

The Senate Passed, April 16th, Assemblyman Harwood's bill, allowing the village of Suspension Bridge to contract for electric lighting, and Senator Hunter's bill, allowing water companies to furnish electricity for lighting.

The Telephone Railway investigation is creating a great deal of discussion, and the final decision will be awaited with interest. A number of witnesses are testifying here this week.

April 17th.—In the assembly, Mr. Adams, of the committee on gas, water and electricity, wanted to have extended till April 25th, the time for the final reporting of his committee. Mr. O'Hare wanted an exception made, so that the committee must report by the 18th the Clarke bill for reducing telephone charges in New York city. Mr. O'Hare was voted down, 34 to 41. Assemblyman Hitt's bill, allowing the Watervliet Electric Railway to cross the Congress street bridge into Troy, went to a third reading.

April 18th.—Senator Erwin introduced a bill, growing out of the investigations of the general laws committee into electrical matters, for the creation of a board of electrical commissioners. These commissioners shall be four in number and shall be appointed by the governor and confirmed by the senate. Two shall hold office four years, one for five and one for six. Two shall be Republicans and two Democrats. After the first appointments the commissioners next appointed shall hold office five years. The board shall have headquarters at Albany, but branch offices may be established under deputies in cities of over 100,000. The board shall have general supervision of all electrical conductors and shall see that they are safely and lawfully operated. The commission shall investigate the causes of accidents resulting in loss of life or injury to persons or property and shall make its report on all such matters investigated. It shall also have power to examine books and papers. The act shall apply to all corporations doing business with electrical conductors for light, power or communication, to all corporations doing business with electrical conductors in any street or through subways. Wherever any corporations doing business in a city of over 100,000 shall be required by the commission to place its wires underground it shall do so. The board shall make such rules and regulations in methods of stringing wires, depositing of poles, methods of bringing the wires into buildings, etc., as may best conduce to the safety of life and property. The board has no power to regulate the strength of electric currents or the rates which companies shall charge for service. The salaries of the commissioners are not named. The bill is framed to follow very closely the lines laid down by the law establishing the railroad commission.

The Amsterdam Street Railway Company was granted permission by the Common Council, last week, to change its road from a horse to an electric road. Thomas D. Mosscrop, of Philadelphia, is in the city and stated to the Common Council that he represented a company that was willing to come to Amsterdam and establish an electric road here and extend it to Rockton. From $100,000 to $200,000 of stock could be sold to Amsterdam parties. H. L.

Albany, N. Y., April 19.

Rejecting Electric Light Bids.

The Gas Commission at its meeting last week virtually decided to reject all the bids lately put in for lighting the streets by electricity, and all three members, Mayor Grant, Commissioner Gilroy and Comptroller Myers, expressed themselves as ready to resume the use of gas lamps throughout the whole of the city rather than pay the prices demanded by the electric light companies. The bids nearly all showed an increase of from 35 cents to 39 cents a night a lamp. Commissioner Gilroy moved that all the bids be laid over indefinitely. His colleagues on the board acquiesced, but Mr. Leslie, representing the Harlem Company, asked to be allowed to read a statement to show that the advance in price asked for was justified, because of the increased expenses the company was under in having to pay subway rent.

Ex-Justice Kelly, who appeared for the East River Company, suggested that the question, whether or not the advanced price was justified, be submitted to a competent electrical engineer, to report to the board.

"No, sir," was the Mayor's response, "a business combination has been formed by the companies, and certain portions of the city have been allotted to each company to get the highest pay possible for the service. I propose, for my part, to light the city by gas rather than give contracts at these high rates."

The bid of the Equitable Gas Company for furnishing over 3,000 lamps with gas at $12 a year for each lamp, was accepted. The Standard Gas Company had put in no bid. Its franchise stipulates that it shall not charge the city more than $12.50 a lamp. This matter had been inquired into, and it was found that chapter 248 of the Laws of 1886 says in relation to this company:

"Said company shall supply gas to the public lamps situated on the line or lines of the mains of said company when required by the said city of New York, at a maximum rate not to exceed $12.50 per annum for each lamp."

It was resolved to take steps to compel the company to furnish the Commission with a record of its mains and through what streets they run, and to light such lamps in these streets as have not already been contracted for by the Equitable Company.

PERSONAL.

Mr. H. H. Walter, of the Card Electric Motor and Dynamo Company, Cincinnati, was a New York visitor this week.

Professor Robert Spice has been elected president of the recently organized electrical department of the Brooklyn Institute.

Col. S. M. Bryan was a visitor in New York last week. This eminent telephone man has several large interests that bring him to New York quite often of late, among them the type-setting machine.

Mr. Timothy Wilson Sprague, formerly of the REVIEW staff, but now of the Thomson-Houston Motor Company, was a New York visitor last week. He has improved in his pool-playing since his trip West.

Mr. Walter C. Wonham, eastern manager of the Hill Clutch Works, has tendered his resignation to that company, to take effect June 1st. Mr. Wonham has a number of friends in the electrical field, all of whom wish him well in whatever future work he may undertake.

Mr. H. McL. Harding, of Chicago, Ill. formerly general agent and recently manager of the mining department of the Sprague Electric Railway and Motor Company, has severed his connection with the Sprague Company; also Mr. J. L. Barclay, special agent at Chicago.

Mr. F. L. Catlin, who participated in the great fast sending telegraph tournament, is said to have recently made the phenomenal speed of 270 words in five minutes in a private trial. At the same time, Mr. Roloson sent 267 words in five minutes. This shows the difference between operating before an audience and in private. Both these gentlemen made a splendid showing in the tournament, but neither reached Mr. Pollock's 260 pace at that time.

A distinguished party, composed of Senator J. R. Thibaudeau, Hon. F. L. Beique, M. P., Messrs. William Cassels, C. W. Hager and J. A. L. Strathy, arrived in Boston a few days ago from Montreal. These gentlemen control the patents of the Thomson-Houston Company for the whole of Canada, and their visit was for the purpose of inspecting the company's works at Lynn. Senator Thibaudeau said that the trip was for their pleasure and information upon electrical matters. He was very much interested, he said, in Boston's electric cars, but thought the deep snows of Montreal would prevent their use there except upon elevated roads.

—— The village of Saratoga Springs, N. Y., will be illuminated with electric lights during the coming season. The resort is to be furnished with a central station plant of 3,000 lights capacity; but, besides that, there will also be an arc light plant of 120 lights. Owing to the fact that the lights will have to be distributed over an extensive area, the machinery is to be of a special kind. A 2,000-volt pressure is to be used on the line. The plant will be furnished with the Westinghouse alternating current system. The new Westinghouse arc light system will be introduced there.

—— A certificate of incorporation of the Tonawanda, N. Y., and Wheatfield Electric Company, has been filed. The capital stock of the company is to be $50,000. Their incorporators named are Herbert N. Curtis and Clarence R. Dean, of New York city, and Arthur M. Travers, of Flushing, L. I. The object of the company is to manufacture electric light, heat and power and sell and distribute the same, also to manufacture and sell steam power, in North Tonawanda and other places in Niagara county. The three gentlemen named are on the board of directors, as are also Samuel B. Hard and Isaac B. Newcombe.

—— Representative Tucker, a member of the joint legislative committee which is now engaged in investigating the subject of municipal control of electric lighting, is reported as expressing himself as follows:

"This move looking to the municipal control of gas and electric lighting, is due to the activity of the Nationalists, as the followers of Edward Bellamy call themselves. They appeared before the legislature to urge the matter, and this committee is the result.

"They fully acknowledge that as soon as they have secured municipal control of lighting, they will urge municipal control of street railways. For my part I can see in it merely a move in the direction of more public officials and more opportunities for corruption."

—— The electric light plant, at the Manufacturers' Club, installed by the U. S. Electric Lighting Company, is one of the features. It consists of a 600-light United States dynamo and outfit. The dynamo room is a marvel of beauty, being tiled throughout, and one entering the dynamo room and seeing the brightly-polished brass and copper work, and mechanical and electrical lay-out, is immediately impressed with the great advance that has been made in this industry. The distribution of lights has been well looked after, and on the whole, the club presents one of the handsomest lit buildings in Philadelphia. It is justly proud of the electric light plant, and the members take great pleasure in showing it to all visitors.

—— A delegation of State Senators and Representatives from Massachusetts, accompanied by Mr. F. A. Gilbert, general manager of the Boston Electric Light Company, and Mr. Clarke Greenough, counsel for the Boston Gas Company, spent several days in Washington and Alexandria, Va., last week, investigating the methods and cost of illuminating by electricity and gas. They had been at Richmond, Va., making an examination of the systems in use in that city, and visited Philadelphia and New York on their return for the same purpose. The agitation of the Nationalists, who are endeavoring to bring the business of illumination under municipal control, has forced the question upon the authorities of several States, as well as upon Congress, and the Massachusetts Legislature has adopted the very practical way of investigating the principal systems now in operation, both under municipal and private control, with a view of obtaining accurate information which will enable it to intelligently dispose of the matter.

ELECTRIC LIGHT NEWS

—— Mexican tramways are to be lighted by electricity.

—— The Electric Light Company, at Martinsburg, will turn on 32 arc and 900 incandescent lights in a few days.

—— The Troy, N. Y., Electric Light Company, has been sold to the Troy Gas Company for $197,000. This gives the Gas Company absolute control of lighting the city.

—— The Edison Electric Light Company and the Gas Light Company, of New Bedford, Mass., have consolidated. The sum of $150,000 has been allowed for the Edison plant.

—— Judge Goeble, of Cincinnati, has issued a decree, permitting the Edison Electric Company to lay their wires underground. The city has filed exceptions to the decree and has given notice of appeal.

—— The Southwestern Electric Light Company, of Philadelphia, Pa., petitioned court for dissolution because it could not get privileges from the city. William H. Embrick is president, and John Pettigrew, secretary.

—— An exact copy of the electric plant by which Kemmler, the Buffalo murderer, will be put to death is on exhibition at the Eden Musee. It is introduced into a remarkably realistic scene in wax called "Execution by Electricity."

—— The Westinghouse Electric Company has been awarded the contract for installing a new central station plant for electric lighting in Portsmouth, Va., with alternating current apparatus. The plant will start with a capacity of 1,500 lights.

—— Every town in Idaho which has water power is utilizing it in operating electric light plants. The Boise electric plant consists of 1,000 lights. Blackfoot has put in a 500-light plant. Moscow has a 750-light plant. Hailey has a 500-light plant. Wallace will have a 650-light plant, and Caldwell has ordered a 500-light plant.

—— A deal is reported to have been made by the Brush Electric Light Company, of Baltimore, and the Westinghouse Company, of Pittsburgh, by which the latter company practically obtains control of the former. The Westinghouse Company guarantees six per cent. interest on $600,000 of Brush stock and five per cent. on $200,000 of bonds, making $46,000 in all, annually, which the Westinghouse agrees to pay for the control of the Brush.

—— The Monongahela Mining Company is about to light one of its mines by electricity. The plant is to be of a special character, so as to make it perfectly safe and economical. A current pressure of 300 volts will be utilized on the line, and the lamps will be placed in series of three throughout the mine. The arrangement in the shaft is such that three lamps can be distinguished at one time. The capacity of the plant is 150 lights, and the Westinghouse Electric Company has the contract for furnishing the apparatus.

—— Before Ensign Gilbert Wilkes left the service of the government to join the Edison Company, it was arranged that he should act for the government in inspecting and testing the Brush lighting plant in the Washington Navy Yard, and he is now engaged in doing that work. The tests will show that this plant exceeds the requirements of the specifications in many important particulars. Commander Bradford, who designed the plant and drew the specifications, fully recognized the difficulty attending the use of high tension currents, but was confident that proper precautions and careful construction, without excessive cost, would render their use perfectly safe and efficient. The work has been done according to this theory, and the result is a model plant which others will do well to copy.

ELECTRIC CLUBS.

ANNUAL ELECTION OF THE NEW YORK CLUB RESULTS IN THE RE-ELECTION OF GEN. O. E. MADDEN AS PRESIDENT.—NEWS FROM OTHER CLUBS IN THIS COUNTRY.

The growth of the electrical organizations of a social and scientific nature has been so noticeable during the past year or two that Mr. A. R. Foote, in charge of the Electrical Department in the United States Census, is to make a detailed report covering organizations of this nature, which will include all the Electric Clubs as well as electrical societies of the United States.

The REVIEW will be pleased to forward to Mr. Foote all statistics regarding these organizations, if the secretaries will forward the same to this office.

New York Electric Club.

The Annual Meeting of the New York Electric Club was held Thursday evening, April 17th, and was quite largely attended. Owing to the absence of the president in Europe, the secretary presided, and stated that the Club was in a very excellent condition, financially, and that new members were continually joining the club, about 400 members being allied with the organization at the present time. Messrs. Stephen D. Field and Henry A. Reed were appointed tellers, and the election resulted as below given. Gen. E. S. Greeley, who had been nominated to the office of vice-president, having declined, on account of numerous other duties and expected absence from the city during the coming year, it will be noticed that Mr. A. H. Patterson, whose interest in the Club has long been known, was elected in his place. There were two or three tickets in the field, and the ticket known as the independent was again successful, the election resulting as follows:

President—O. E. Madden.
Vice-presidents—Grosvenor P. Lowrey, A. H. Patterson, Erastus Wiman and W. D. Sargent.
Secretary—Chas. W. Price.
Treasurer—Willard L. Candee.
Board of managers—J. C. Chamberlain, H. L. Storke, H. D. Stanley, H. C. Adams, J. J. Carty, Geo. B. Coggeshall, Cyrus O. Baker, Jr., Samuel Insull, John A. Seely, C. H. Barney, J. H. Herrick, C. E. Stump and Henry A. Reed.
Committee on membership—Henry Hine, chairman; Lieut. F. W. Toppan, Geo. T. Manson, F. Z. Maguire and Geo. Worthington.

The Evening of the Annual Meeting a *table d'hote* dinner was served by the new steward and both in service and quality was pronounced one of the best ever enjoyed at the Electric Club.

The Election seems to give very general satisfaction, and it is predicted that during the next year the Club will make more progress than any year during its past history.

Among the Recent Visitors to the Electric Club from out of town were, Morris W. Meade and R. McClatchey, of Pittsburgh; Geo. B. Clarke, Washington, D. C.; Frank E. Stevens and Geo. E. Vail, Boston; A. Singer and T. J. Lovett, Chicago; J. S. Drake, Los Angeles, Cal.; G. M. Griffith, Philadelphia, Pa., and M. C. Orton, Chicago.

This Club opens the new year with particularly bright prospects, and is the headquarters of all visiting electricians, not only of the United States, but of Europe.

Col. H. C. Davis, for nearly three years the president and active spirit of the Electric Club, is visiting in the city, having recently returned from London, where business calls him a great deal of the time. No officer or member of the Club has more friends in it than Col. Davis, and his appearance at the Club recently was the cause of numerous warm welcomes on the part of his friends. While in New York Col. Davis makes his headquarters with his son, Mr. Carl Davis, the electrical engineer, 120 Broadway.

The Election of Mr. A. H. Patterson as one of the vice-presidents of the Club is a deserved recognition of his work as well as his generous gifts to the Club in the past. No more popular member in the Club is to be met with than Mr. A. H. Patterson, and no more graceful and entertaining presiding officer either, for that matter.

Gen. E. S. Greeley, who was nominated for the office of vice-president, is also president of the Union League Club of New Haven, and owing to this fact and his other numerous duties, in a very courteous and complimentary letter to the Club, declined to stand as a candidate for the office of vice-president. Gen. Greeley is one of the recognized standard bearers of the electrical industry, and had he not declined, would have been unanimously elected; but as it is, and as he stated, the Club may count on him for his earnest work and well wishes.

The Meeting of the New Board of Managers of the Club will be held the evening of May 8th, at which time it is expected that the re-elected president, Gen. Madden, will have returned from Europe, and committees for the year will be appointed. This is a very important part of the work, as much of the progressive work of the Club is performed by the committees. In this respect the Club has been particularly fortunate in the past, as members of the different committees have been zealous in their work for the good of the Club.

Chicago Electric Club.

One of the Most Active Members of this organization, Mr. H. A. Glasier, died recently in Chicago. He was very popular in that city, and numbered friends in all parts of the country. Mr. Glasier was an old soldier, having served through the rebellion, and earning the distinction of captain by his bravery and daring on the field. After the close of the war he took up the study of engineering, and was for a number of years connected with the Jarvis Engineering Company. His death occurred on Tuesday, April 15th, and was sudden and quite unexpected, resulting from an affection of the heart. Mr. Glasier leaves a wife and two sons to mourn his loss.

Boston Electric Club.

The "Cranks" Dinner, which takes place every Thursday evening, continues to be one of the most pleasant of the many social entertainments at the Club rooms.

Several applications for active membership have been handed over to the membership committee during the past fortnight. Several of the officers of the West End Railway Company will soon join the Club.

The Ladies' Reception, which will take place at the Club rooms on next Wednesday evening, will prove one of the most enjoyable, as well as the most notable events that has occured under the auspices of the Boston Electric Club.

Dr. A. de Bausset continues to cast a "wishful eye" toward the Washington patent office. Many of his friends think it is merely a question of time when the Doctor's air-ship, "Enterprise," will materialize, notwithstanding the views of the patent office authorities.

The New England Electric Exchange.—The annual meeting, on Monday afternoon, at the Club rooms, was one of the most harmonious gatherings ever held by this organization. In another column an account is given of the proceedings of the Exchange and the election of officers for the ensuing year.

The Club Dinner, at the "Quincy," last Monday evening, was a success in nearly every respect. The most enjoyable feature of the dinner was the reading of a paper on "Electric Railway Evolution," by Mr. Joseph Wetzler, editor of the New York *Electrical Engineer*, to which paper a more extended notice is given in another column.

Harvard Electric Club.

There will probably be but two or three more public lectures this Spring. Next Fall it is the intention to give a series of six or eight. This does not include those lectures open only to members of the Club.

The Boston *Commercial Bulletin* has wisely concluded to change its form from the "blanket sheet" to the popular quarto size. In doing this, the *Bulletin* preserves all its excellent original features, makes several improvements in the arrangement of matter, and gains over a column of additional space. The *Bulletin* has long been noted for the fullness and accuracy of its financial, market and manufacturing news, and the intelligence and completeness of its insurance, trade and commercial reports. With its new form and improvements, it bids fair to make a still further advance in popular favor.

"The Evolution of the Electric Railway."

A PAPER READ BEFORE THE BOSTON ELECTRIC CLUB, APRIL 14, 1890, BY MR. JOSEPH WETZLER, OF NEW YORK.

The theory of evolution, as now generally applied to organic life, has reached a point of development where it may be considered to have almost attained to the position of established permanency, and which the many facts adduced all tend to strengthen. While the theory is applied to man, in so far as his bodily organism is concerned, it may be claimed to go further, and I think it cannot be difficult to trace its processes not only to the whole organism, but to the products of his brains and hands as well. Every step in advance now recognized as of benefit to mankind has been the result of an evolution of thought combined with an evolution of practice. Take, for example, the steam engine. What changes has it not undergone and what form has it not assumed since the day of Watt? Consider, if you will, for a moment, the various types into which it has differentiated, each of which is best adapted for certain conditions, localities and circumstances, quite analogous, indeed, to the way in which Darwin and Huxley have pointed out the variations which changes of locality, climate and proximity to natural enemies, have brought about in the animal species. To this general evolution which is constantly going on, both in the material and the spiritual world, the electric railroad is no exception.

In order to be logical, let us briefly refer to the past for the purpose of making our record complete. History tells us that as far back as 1835 attempts were made at electric locomotion, and for 40 years spasmodic efforts in this direction can be traced through the annals of electricity, including the work of a number of men, among whom American inventors are by no means the least conspicuous. What were the elements in these early locomotives? They were, first, the electro-magnetic motor, and second, the primary battery. The combination of these two crude, or, as we may say, rudimentary elements, was evidently not calculated to bring the electric railway into the field of practical use. Nevertheless, they were a starting point, and though unsuccessfully worked out, the time and labor spent upon them cannot be said to have been wholly wasted. Indeed, we may consider, and be able to show later on, how a succeeding development may, by force of circumstances, revert to an original form long extinct or forgotten. But we must pass on to the time when we find the dynamo to be a *fait accompli*, and the reversibility of the dynamo a well-recognized effect.

With these powerful allies brought to its aid, and, we may add, its natural enemy, the primary battery, at last made harmless, the electric railway received another strong impulse of development, and arrived at what we may call the second stage in its evolution. Let us examine for a moment the elements as employed by the early workers in this field, and constituting what may be called the electric road of 10 years ago, and up to and including that of recent date.

We have:

1. The generator.
2. The insulated conductor from generator to car.
3. The motor on the car.
4. The gearing from motor to axle.
5. The return circuit to the generator.

Let us take each element separately, and see what changes have been brought about from that period of 10 years ago up to the present. Taking up the generator first, it might be said that it be would be difficult to trace any particular change which the influence of the electric railroad itself might have brought about. But even here, we can discern certain tendencies which may show themselves more markedly at a future period, and which seems to evolve in the direction of large multipolar dynamos of comparatively slower speed than the familiar two-pole machine generally employed at the present time.

But we pass on to our second element, the insulated conductor. Siemens, Daft, Edison and Field, and others, started out with one rail, or an independent central rail insulated from the ground, as their main conductor, connecting generator and car. The restrictions which such a mode of carrying the current obviously placed upon the operations of the road soon became apparent, however, and the step from a conductor placed upon the ground to one suspended above it was but a natural one. What do we find as the first attempts in this direction? The weight of the motor being no longer available as an additional means of insuring good contact between the conducting rail and the wheel bearing upon it, Siemens conceived the idea of employing the split tube, in which a slider acted as a contact device. The inconveniences of this arrangement, however, also soon became apparent, and the plain cylindrical wire took its place, and has maintained its position up to the present time. The sliding contact inside the split tube was then converted into a trolley-wheel, which at first, and most naturally, was placed on top of the wire, riding upon and supported by it, the weight of the wheel insuring the integrity of the contact. But the trolley-wheel riding upon the wire was soon found to be accompanied by certain inconveniences, and the next step in this development was to place the trolley on the end of a pole and press it in contact with the wire from below, by which means not only is all strain removed from the wire, but the latter is actually supported during the passage of the wheel in contact with it. This development so briefly sketched here, was, however, the result of innumerable experiments, and the various forms which the trolley-wheel has taken in the past would alone make an interesting chapter in a volume descriptive of this work.

While on the subject of conductors, also, we may turn aside to look at the state of the art as far as it includes placing the conductor below the surface of the earth. This was early suggested, but its development has been delayed; not, I am certain, from any inability to successfully settle the problem, but for reasons which you probably are all aware of, and which involve merely financial considerations.

We come now to the motor. Here we find a still larger field than we have heretofore met with, although, in general principles, of course, all the evolutions going on are alike. Starting out with the practice of employing but one motor to each car, time and circumstances seem to have dictated the use of two motors, which are generally in use at the present time, and the reasons for the adoption of which seemed eminently sufficient at the time the changes were made. Principal among these were the facts that by the employment of two machines power was transmitted directly to two axles independently, instead of to one, as theretofore; again, it admitted of smaller machines being employed which could find easier place under the car body; and, for the reason which was once broached, but which we believed the electric railroad has outlived, viz., that in case of the breakdown of one machine, it would allow of the car being brought home by the second for repairs. In connection with the motor, also, and intimately related to it, is the method of regulation and the type of machine employed. Starting out with the employment of external resistances placed in the circuit for the purpose of regulating the speed of the motor and car, this differentiated in some quarters into the combination of the field magnets of the motor to effect the same purpose, although the method originally adopted is still adhered to by some as being preferable.

We must leave this point for the present, and pass on to the gearing by which the power of the motor is transmitted to the axle on which the wheels are mounted. While up to the present, the elements that we have been considering were practically new, and, therefore, amenable in the highest degree to the process of evolution, the gearing of the car at once gave a wide scope to the electric railway engineer, by placing at his disposal mechanical devices, many of which had been in current use for years and years in other work, and which his own ingenuity increased in number and changed to suit his own particular needs. As a result, we find that one of the first devices used for transmitting the power from the motor to the axle was by the well-known belt. Then came the friction gear, which, in turn, was followed by the chain and sprocket wheel, and this by the worm and wheel, the direct crank motion, until we arrive at the present most general form, the gear and pinion. Before this point had been reached, however, a multitude of devices, modifications of those above mentioned, were employed or suggested. Even in the method at present in use, what changes have we not seen, and what has not been tried to overcome some of the difficulties experienced, due to the wear and tear, etc., to which such gearing is subjected? I need only refer to the various materials which have been employed for the construction of the gears to make them durable and noiseless, among which gun metal, raw hide and steel, and others, have figured prominently. Unfortunately, thus far, where one material has been found good in one case, it has been found defective in another.

We would pass on, however, to the fifth and last element in the electric railway system, that is, the return circuit from motor to generator. The ground return, which was the earliest form employed in the modern electric railway, may be well considered to be the prevailing one, for although the rail is brought into service, it is merely as an auxiliary; but, on the other hand, the metallic return is also employed to some extent, and, in some respects, presents advantages which cannot be denied, and of which we shall have occasion to say more later on in discussing its probable development in this direction.

We have thus traced in rapid review the changes which the electric railway has undergone up to the present day, and having

thus briefly sketched the process, as it were, by which this state of development has been reached, let us follow out the line of thought, and see if we can determine in what direction and in what manner further evolution will take place. Evolution, as a rule, tends constantly to the production of a higher type—one which is better adapted than its predecessor to the surrounding conditions. The electric railway may, and I am sure it will, develop into a better and higher type. As Dr. Joseph Cook, of your own city, would say, it will harmonize better with its environments. The employment of the word "better" naturally implies a certain inferiority in the present state of the art, and while no one is more impressed with the magnificent progress made during the past decade (progress against heavy odds, ignorance and conservatism; and the antagonism of vested rights or vested wrongs), it would be folly to say that the electric railway of to-day is perfect. Indeed, it would be against the laws of nature, and stamp the art as one incapable of improvement, than which no greater ill could befall it. Electric railroading being an eminently progressive art, therefore, let us see if we can discern in what direction evolution can be looked for. But, before going further, I deem it proper to say here, that in what follows I do not wish to be considered as in any way criticising the electric railway system of to-day, for you and I know but too well that even in the present day it stands without a rival. I wish merely to hint at the direction in which still higher perfection may be reached, and this can best be done by taking up the elements in the order first named.

Taking up the generator, therefore, I think it will be conceded that it has even to-day reached such a standard of perfection that little may be expected in the future in the way of an increase in its efficiency, and the changes which do take place will be more in the direction of cheaper construction, and possibly, as the tendency seems to be largely to-day, towards reduction of speed.

But when we come to the conductor by which the motor is fed with the energy necessary for its propulsion, we encounter the element which is, indeed, one capable of some evolution, and when we use the word "conductor," we mean not only the wire but all those elements which are subsidiary to it, and which go to make up what we call the conductor system as a whole. I use the word "evolution" advisedly, in contradistinction to the word "development," for while development in detail is naturally to be expected, the process of evolution which the electric railway is passing through at the present time may make entirely unnecessary the existence of such a system of conductors. I imagine that many of you have already divined what I am about to call attention to, and that is, the presence and the possible influence of the storage battery on the progress of electric locomotion.

Though storage batteries may be said to be in successful operation in a few instances at the present day, notwithstanding the difficulties which their employment presents, due, principally, to the large weight necessary for obtaining the required power, is it likely that the art of storage battery making will remain stationary, and that no improvements in that direction are to be hoped for? I certainly cannot bring myself to believe that such is the case; indeed, I am convinced that with the large number of workers in this field, the next five years will produce a battery which will be adapted to railroad work, not only by its construction and durability, but chiefly by its lightness compared with the power which it is able to develop. With such a battery in the field, applicable to the heaviest work, you can well see that the entire complexion of the electric railway situation will be changed, so far, at least, as the question of conductors is concerned.

But, given that the surmise just ventured should not be realized, will the present type of conductor be maintained in the future? The type most generally employed at the present time is the overhead single conductor, carried on a pole, or on span wires; while, on the other hand, the complete metallic circuit is also to some extent coming into use. Already we hear mutterings of complaint from certain quarters, relative to the inductive effects caused by the arrangement with the single wire and ground return. Whether or not the change to metallic circuits will be made, will, I think, depend more upon the decision of the courts than on the relative merits of the two systems.

The question whether the conductors of the future in large cities will be placed underground, is, in a certain sense, problematical, in view of the fact before pointed out, that the near future may make the consideration of conductors out of the question by the employment of storage batteries as a secondary source of energy on a car. But again, on the assumption that storage batteries will not be forthcoming, the paths open in the consideration of underground construction lead in various directions. Will it be a pair of bare conductors from which current is taken and returned by means of brushes attached to a car and project through a slot in the street? Or will it be one of those ingenious methods in which the conductor is insulated throughout, but connected at intervals with the track which it energizes locally at the spot which the car happens to be traversing at any instant? These are questions which it would be difficult to answer.

Still I think it is fair to assume that the overhead system will continue in use for a considerable period of time, even in the largest cities, and the evolution which may be looked for, is a thorough standardizing of all the details. It is not improbable either that the general type of overhead construction may be materially modified by the substitution of a light and graceful truss spanning the street in place of the span-wires now employed. There are undoubted advantages in such a construction, both as regards safety and economy of maintenance. Such a system might also to a considerable extent lessen the number of posts placed in the streets, as it would permit of longer spans than are deemed advisable at present. Again, the conductor system of the future will, I think, largely resolve itself into a system built up of small units or sections intimately connected and interlaced, and supplied with independent feeders. Such a system is specially desirable in large cities, where interruptions on one part of the line, due to street blocks, fires, processions, or even a break in the circuit, etc., may necessitate a detour of the cars and their massing on other sections of the line. Ample feeder capacity and small sections will thus make a general stoppage of traffic impossible. Unquestionably the place best adapted for the conductor, every thing considered, is overhead.

I must leave those problems to your consideration and, I hope, for your discussion later on to-night, and pass to the next two elements, which we will consider together, that is, the motor and the gearing which connects it with the axle.

Briefly recalled, the present practice may be said to consist in employing two motors, running at high speed, connected to the axles through gear and pinions, which on an average, effect a reduction in speed of 12 to 1. I think we can already discern more than one change which the near future will bring about in both these elements.

Taking up, first, the employment of two motors, I think it is not improbable that we shall find a reversion to the older type to be the next process in the evolution of the electric railway; that is, that the motor will probably in the future be employed to drive the car, connected to either one or two axles. Let us see the reason for this. Although two motors may be built by the same hands, it is a physical impossibility to build two alike. This means that such motors placed on a car and connected to the same switch, and, as a rule, connected in parallel, will act unequally, one taking more current than the other, and introducing irregularities in working which one motor alone would not produce. Again, the loss which takes place on starting the car from rest to motion is almost double when two motors are employed, as compared with the case where but one is employed, owing to the fact that at the low starting speeds the motor has not had time to obtain its maximum efficiency of action.

Again, it not infrequently occurs that the car in starting, takes anywhere from 50 to 100 amperes of current through the two motors; but, I believe, that experiments have demonstrated that if one motor alone is employed, the draft of current at the starting would not be nearly so heavy as just indicated.

Again, looking towards the future of heavy city traffic, the question also forces itself upon the mind whether accumulated experience may not prove that greater economy is to be obtained in the use of individual electric locomotives or motors which shall draw a train of two or more cars, instead of the present method of providing each car practically with its own motive power equipment. Take, for instance, the condition of affairs in your own city. With the different styles of cars, box and open, only one style can be on the road at one time, and, of the 2,000 cars, probably 1,000 are constantly idle. But each of these 1,000 must be fully equipped for work at a moment's notice. This means an enormous outlay, practically unproductive of profit, and requiring care for its proper maintenance. If individual motors were employed, only 500, say, would be required, to draw any style of car, a number at a time, the cars being of the ordinary type, without motor equipment. This is an important question, which, I think, will soon command prominence, and which would be an apt example of reversion to a type practically extinct at the present day, though the first employed.

Passing on for a moment to the method of connection of the motor to the car axle, I believe that those persons who have had practical experience of electric railway operation will agree with me that evolution in the direction of electric car gearing will develop remarkable changes in a very short time. Notwithstanding the great ingenuity which has been exhibited in this department of car gearing, and the truck arrangement generally, certain inherent difficulties have developed themselves in this direction which, it is now well recognized, must be eliminated. Taking the gear as the working medium alone, the high speed at which electric motors are operated at the present time is proving very destructive, and from the gear and pinion, each made of cast iron, we have passed successfully through steel, bronze, and other composition mixtures, raw hide and steel fibre. While each possessed its own particular advantage it was also accompanied by a disadvantage. Thus, for instance, the raw hide and steel pinion very soon developed a trouble, which consisted in the grooving of the meshing gear, which soon made its substitution by a new one absolutely necessary. In this direction alone much can be done, as I have already pointed out.

Again, as the high speeds employed in the motor are, in a great measure, responsible for these troubles, the remedy seems obvious, and is, I believe, already about to be applied in the employment of slower speed motors, and the reduction in the number of steps in the gearing from two pairs to a single pair; in other words, in the reduction of speed from 12 to 1 to something in the neighborhood of 5 to 1. This will probably involve the evolution from the two pole motor to a four, or more, pole motor on the car.

Looking at the question from another standpoint, that of efficiency, or, to put it in plain language, that of the coal pile, I think another illustration of the present conditions can best be shown by alluding to the fact that the results of tests show that nearly 50 per cent. of the energy developed by the steam engine is lost in its various transmutations from the dynamo to the car axle. Placing the loss in the dynamo and in the line at 20 per cent., we have an additional 30 per cent. lost in the motor and the gearing. This excessive amount is one which, I believe, can be considerably reduced, and the remedies suggested have been various. In the first place, there can be no question that the present practice of stopping and starting the motor, by which enormous drafts of current are taken upon starting, can be overcome by a change in the electrical design of the motor and the switching arrangements. On the other hand, it has been suggested that the low efficiency at which the motor operates before it attains its normal speed, can be overcome by an arrangement in which the motor is constantly revolved at its most economical speed, independently of the movement of the car, by providing a suitable gearing by which the motion can be transmitted to the axle. It may be argued that this method may introduce other difficulties, especially in the gearing; but as a principle, pure and simple, it must be admitted to be an idea which is well worth consideration, and which may be developed to good advantage. The other fraction of the 30 per cent. lost between the engine and the car axle, is evidently in the gearing itself. It is evident, of course, that every stage in the transmission must involve some loss, but the excessive amount which appears to be lost at present seems certainly capable of diminution. The change from the present high speed motor, and its double reduction of speed through two pairs of gear with a slow-speed motor and a single pair of gears, will, I think, effect a large gain in the direction just pointed out, and we shall probably soon be enabled to judge by experience of the practical value of this arrangement.

As regards the return circuit of the future, whether it shall be overhead, underground or through the earth, depends largely upon circumstances. In view of the rapid spread of æstheticism in this country, notwithstanding the noble lead which your own city has taken on the question of overhead conductors, it seems doubtful whether in many large cities that type of construction can be maintained, and granted that it is, will the present type of construction be continued? It is probable that if it is, it will resolve itself into the system which is already gaining ground rapidly, in which the main feeders will be placed underground, and the working conductors placed upon poles through the center of the street where double tracks are employed. These poles will not only be available for the suspension of electric railway conductors, but will also serve as supports for the arc and incandescent lights used in the illumination of the streets. As pointed out before, however, the question is one which, in view of the presence of the storage battery, is difficult to discuss, so far as its future aspect is concerned.

But, finally, looking generally at the question of the future of electric railroading, and speculating as to its probable extension for traffic other than for street and suburban service, it is proper to consider whether the electric railway will eventually replace the steam engine for trunk lines. While such a change is, of course, by no means impossible, considered from every standpoint, it is probably one which will not come to pass for a long time, if for no other reason than the conservatism of the average railway man. But aside from this aspect of the case, an analysis will, I think, show that there are certain defined limits beyond which electric railroading may not compare with the direct steam locomotive. I have not made a sufficiently close study of this aspect of the case to give any actual figures, and I believe that we shall soon be afforded some definite information on the subject.

But there is still a field for the electric railway beyond mere city traffic, which will, I think, shortly develop into considerable proportions, and that is in the operation of branch lines to the main steam railway lines, and as connecting links between them. There are many places where such lines, in many cases less than 50 miles in length, could be economically worked on the electric system, and that the advantages afforded are already recognized, is evidenced by the fact that the idea is already being put in practice. As an example, I may mention the fact that at Sunbury, Pa., the connecting link between the Lehigh Valley and the Reading Railroads, is an electric railroad, which was contracted to be operated at a speed of 25 miles an hour, and which carries both freight and passengers between the two systems, including in its length the passage through a bridge a mile long. The motor of the electric car is 30 horse-power, and a single one is employed. The advantage of such feeders to main lines is still more apparent when we consider the large distances separating the main lines of railways in the far West, where frequently hundreds of miles intervene between parallel railway lines, and where electric roads might be reticulated.

The probable development of the electric railway might be followed out in a great many more directions, but I think enough has been said to prove that the changes which will take place will be extremely rapid, and that the electric car and the electric railway system generally, of 10 years hence, will be quite unlike that of the present day.

I regret very much that the time at my disposal has been insufficient to present a more elaborate and better digested treatment of the subject, and, indeed, what has been said is intended more as the basis for a discussion of the subject, which I hope will be indulged in, than a thorough treatment of the same.

The Brooklyn Edison Station.

On a recent evening, a large number of people were present in the Edison Electric Illuminating Company's new building, on Pearl street, near Myrtle avenue, Brooklyn, in response to special invitations sent them to inspect the new plant.

At an early hour the residents on Pearl street were astonished at seeing the front of the building decorated with incandescent lamps, which changed color every 30 seconds, while over the archway above the main entrance was a large revolving wheel of lighted colored globes, so arranged as to show each line of color distinctly, the general effect produced being agreeable to the eye. The rows of lights across the front of the building were of different colors, so connected as to change the lights from one hue to another and back again.

As the guests entered they were conveyed to the third floor of the building, where the offices and show-rooms are located, by means of an elevator operated by electricity, where they were received by Mr. Ethan Allen Doty, the president of the company, and Mr. Edison.

In Secretary Royal C. Peabody's room the phonograph was displayed. This remarkable machine was primed with music and witty sayings, which those present listened to with appreciative ears.

In the directors' room, representatives of the Wheeler and Wilson Company showed how easy it was to operate a sewing machine by electricity. In this room the motor for operating fans was also on exhibition. The other rooms on the third floor were the testing room, where the indicators and other testing apparatus were exhibited; and the meter room, where the measurement of electricity was explained in a manner that would have put the average gas bill collector to blush; the draughting and store-room, the workshop, in which a lathe and drill were displayed, operated by electric motors, and the show-room of Bergmann & Company, manufacturers of electric light and gas fixtures, where all kinds of chandeliers and other fixtures on which incandescent lamps were used were displayed. Several pretty effects were produced in colored lights. In the rear lobby, a Sprague electric mining hoist motor in operation was exhibited.

On the other floors and in the basement were the arc light department; the 10 horse-power electric motor, operating the freight elevator; the dynamo department, in which the Edison dynamos are in operation supplying light and power over the circuit owned by the company, the gallery on which the switches controlling the dynamo currents are controlled, the tubes and coupling boxing and the cables; the engine and boiler rooms, and the pumps and artesian well. All of these places were visited, and in every room there was everything of interest to attract attention and excite inquiry.

KINDRED INTERESTS

The stockholders of the Northwest Electric Construction and Supply Company, of St. Paul, Minn., held their annual meeting last week and elected the following board of directors for the ensuing year: E. R. Gilman, George C. Duffie, Thomas C. Sullivan. W. G. Decelle, H. K. Gilman, J. B. Tarbox, V. M. Watkins. The directors then met and re-elected E. R. Gilman president and general manager, George C. Duffie, treasurer, and W. G. Decelle, secretary.

The Westinghouse Electric Company has fitted up a department in the Garrison alley works, for the manufacture of street railway motors, under patents controlled by the company. Concerning the matter, one of the officials said: "We have definitely decided not to enter the electric trust proposed by the Thomson-Houston Company. The main support of it and a few other companies, has been their business in street railway motors. We now intend to enter into competition with them under exclusive patents of our own."—*Pittsburgh Leader.*

The Armington & Sims Engine Company, of Providence, have received an order for three double upright 7x5 engines for the new government cruiser, "Newark," which the Thomson-Houston Company will light. These engines are to be strictly of the marine type, with many new improvements, giving the greatest amount of power for the least weight and square foot of floor surface. They will not be compounds, as recent and exhaustive experiments by the French and English Navy Departments have condemned the small compound engines for ship lighting, and this contract has, in a measure, been awarded and based on their experience.

The North Western Electrical Supply & Construction Company, of Seattle, Wash., have closed the contract for the complete electrical equipment of the new Denny Hotel, of that city. In addition to the Edison system of lighting, the work will include the Partrick & Carter needle annunciator of 300 numbers, with fire alarm and return calls. Each room will be fitted with a P. & C. combination bell and push. The Levens Electric Company have contracted with the Park Hotel of Hot Springs, Ark., for a 300 number Partrick & Carter needle annunciator, with fire alarm and guest call. A feature of this equipment will be the new bronze metal bell and push combined, made by Partrick & Carter.

Chas. A. Schieren & Company have just received an order from the Citizens' Electric Illuminating Company, of Brooklyn, N. Y., for 98 5/12 feet of 42 inch three-ply "Electric" leather belting. They previously sold this company

106 feet 42 in. double "Electric" belting.
98 " 42 " " "
115 " 36 " " "
115 " 36 " " "
89 " 36 " " "
89 " 36 " " "
115 " 36 " " "

for main drive, and all the necessary dynamo belts, in addition to this. They also furnished the Municipal Electric Light Company, of Brooklyn, with

109 7/12 feet 48 in. double "Electric" belting.
113 " 48 " " "
93 5/12 " 20 " " "

for main driving belts, and about 325 feet of eight inch double "Electric" belting to run their dynamos.

Westinghouse Union Switch Company.

The Union Switch and Signal Company stockholders held their annual meeting recently. The annual report showed that the earnings from sales for the 12 months ending December 31, 1889, were $575,749.29, the operating expenses, $513,613.94, the interest and discount, $39,065.54, leaving as net earnings, $23,069.81. The financial statement showed the available assets to be $604,383.08, the unavailable assets, $1,297,931.77, making the total assets of all kinds, $1,902,314.45; it also showed the liabilities to be $2,194,197.01, leaving a balance to debit of profit and loss of $291,882.56. To the available assets ($604,383.08) is to be added the unissued preferred stock, amounting to $129,900, making a total of available assets of $734,239.08, with which to meet a total indebtedness, exclusive of bonds, of $519,247.01, leaving a working surplus of $215,036.07. President Westinghouse stated that the amount of preferred stock sold to date at par was $370,100. The business of the company is in a very satisfactory condition.

The Production of Copper.

From a recent statement in the London *Financial News*, it appears that when the French syndicate collapsed, less than a year ago, copper fell in a few days from £80 to £35 per ton, and if it had remained at this low price it is probable that the stimulus given to consumption, coupled with the check to production, would have led to a marked improvement in the position of the market. The immense stocks might then have been steadily reduced until they reached a normal amount, when a permanent improvement in prices would have been justified. But the copper market was bolstered up by those who were left as the heirs to the stock accumulated by the syndicate, and as a result of the advance in prices the present supplies in England and France still stand at 95,000 tons, as against 125,000 tons in March, 1889. In other words, a year of extremely active trade has only effected a diminution of 30,000 tons in the public stocks, which are still twice as large as they were when the French speculators first turned their attention to the copper market. On the score of consumption there is no cause for complaint, for the deliveries in England and France in the year ended February 28 last, amounted to 134,000 tons, against only 59,000 tons in the preceding 12 months; but those who anticipated a diminution in the production have been greatly disappointed, for, instead of a falling off, there has been, according to the annual return compiled by Messrs. Henry R. Merton & Company, an increase of nearly 4,000 tons. These statistics, are, in some cases, only estimates, but they are, probably, very nearly accurate. From this return we take the following figures, showing the production in the past four years:

	Tons			
	1889.	1888.	1887.	1886.
Australia	8,300	7,450	7,700	9,700
Chili	24,250	31,340	29,150	35,025
Cape of Good Hope.	7,400	7,300	7,250	6,025
Germany	17,356	15,230	14,875	14,465
Japan	15,000	11,600	11,000	12,000
Russia	4,070	4,700	5,000	4,875
Spain and Portugal.	57,000	57,300	58,706	49,653
United States—				
Lake Superior	38,769	38,650	33,330	35,590
Montana	46,518	43,703	35,225	25,730
Arizona	14,419	14,062	8,035	6,985
Other States	6,068	5,295	2,519	1,510
Venezuela	5,563	4,040	2,900	3,708
Other countries	18,386	18,596	13,383	11,880
Totals	262,990	259,126	228,973	217,136

From this, continues the same authority, it will be seen that, with the exception of Chili, where in 1888 production was forced on at a pace too great to last, there was last year an increase in the supply of copper from nearly all sources, the production of the United States and Japan exhibiting a marked increase. The Spanish and Portuguese figures are estimates only, but they show an increase of 2,300 tons in the output from Rio Tinto, with a decrease of 1,750 tons from Mason and Barry. The output of the New Quebrada mine, in Venezuela, has increased from 2,900 tons in 1887, to 5,563 tons last year, and some of the smaller producing countries also show an augmented output. The diminution in the supply from Chili has taken place mainly since the fall in prices, but for some months past there has been an increase in the charters, so that any hopes founded upon a continuation of limited shipments from that quarter, are unlikely to be realized. Taken as a whole, the statistics show that, at the present range of prices, the tendency is for production to increase rather than to diminish. So far as can be foreseen, the probability is that consumption will do little more than keep pace with supplies—if, indeed, it does that—and, hence, it is evident that anticipations of an improvement in copper and copper mining shares are not warranted by the present conditions.

Using Natural Power.

A company which has been formed in Hartford proposes to build a dam across the Farmington river at Tariffville, Conn., put in dynamos, etc., and generate electricity, which is to be conveyed by large copper rods, strung above ground, to Hartford, 11 miles away. About 2,000 horse-power will be turned into electrical energy. The Hartford Electric Light Company has agreed to use a portion of this energy, enough, in fact, to supply its patrons and light the streets. The surplus power will be used for electric motors in factories and elsewhere. The contract with the electric light company is so drawn that the power company is sure of a good return on its investment. The names of the promoters of the scheme have not been made public. Work on the proposed dam will begin at once.

New Power Station.

The Boston *Commercial Bulletin*, of April 5, contains the following:

"Foundations have been laid for the new electric power station of the West End Railway Company, in Cambridge, on the old site of the New England Glass Works. When finished in the fall, the station will furnish current for 270 cars in summer and 200 cars in winter. It will have ten 250 horse-power dynamos. The Cambridge Electric Company has the contract to furnish power for the summer and until the new station is ready next fall. The West End Company will lay a great deal of new track this season, probably 50 miles in all. The girder rail will be used, set longitudinal on a stringer which in turn will lay upon ties. The rail is steel, three inches high and the stringer 4½ inches high, making the total height 10½ inches. The tread will be about ½ an inch above the paving and the tram will be about ⅜ of an inch below the paving. From the top of the tram to the top of the tread will be about 1⅛ inches, which will give an opportunity for deeper flanges on the car wheel.

"The company finds the old horse car rails inadequate for electric purposes and intend to replace it with this new track which is efficient in keeping the electric cars from derailing. The wheel flanges of the new electric cars will also be enlarged to ⅞ and probably ⅞ of an inch, the present size being ⅝ of an inch. It is proposed to lay this new track in the following districts: Tremont street and Washington street from Boylston to Dudley streets; the lines using electrics running from the Tremont House to the Nothern depots; Grove Hall to Dorchester; from Egleston Square to Forest Hills; from Tremont street to Jamaica Plain; from the Common to Mt. Auburn; from Union Square, Somerville, into Craigie's Bridge; from Charles street to Park Square; Washington street to Brighton; from Cambridge street to Oak Square; Columbus avenue, Berkeley street and Dover street.

"The company has placed orders for 32 new electric cars which will seat 40 passengers and will be ready in two or three months. These cars will have double tracks, the wheels on each track will be 4½ feet apart, and will run along as steady as a steam railway car. The company has also placed orders for six double truck Robinson radial cars."

The managers of the Federal Street and Pleasant Valley Street Railway, of Pittsburgh, Pa., which has been operating 25 motor cars on the Sprague electric system for some time, have ordered an additional equipment of 14 motor cars. This road now extends in the city of Allegheny, over the line of the early electric railway on University Hill, which used the Bentley-Knight system, with underground conduit, and was one of the first installed upon that system. The regular method of overhead contact is now used on this section of the road, as well as upon the rest of the line, and the conduit has been abandoned. The grade surmounted by the electric cars upon this road is quite severe, being in one place about 12½ per cent., the length of the grade being over a mile. With the old electrical equipment, this grade was considered too steep to be ascended in the ordinary manner, and at the steepest part a rack was used between the tracks in which a pinion connected with the motors engaged, in order to secure the necessary traction. With the new equipment, this arrangement is found to be unnecessary, and the Sprague cars have no difficulty in ascending the grade, with the aid of no other traction than that which the wheels secure from the rails themselves. There are now over 30 cars in regular operation upon this line.

New Offices of the Thomson-Houston Electric Company, Boston, Mass.

As briefly alluded to in these columns recently, the above named company has leased additional offices—occupying the entire second and third floors—in the "New England" building, connecting by bridges with the company's old quarters in the adjoining ("Hathaway") building.

The increased accommodations afforded by the new offices will facilitate the prompt handling of the Thomson-Houston Electric Company's large and steadily increasing business.

The following named departments of the company will remain in the "Hathaway" building, viz.: Secretary and assistants, engineer, assistant engineer and draughtsmen, shipping department, book-keeping department, isolated electric lighting department, and stationary electric motor department.

FIG. 1.—"HATHAWAY" BUILDING, ELECTRICAL HEADQUARTERS, BOSTON.

The large and pleasant offices on second floor, occupied until recently by the company's railway department, will be hereafter used as the headquarters of the electric motor department.

Herewith we present illustrations (Figs. 1 and 2) showing front and side elevations of the "Hathaway" and "New England" buildings, respectively.

Fig. 1 represents the "Hathaway" building fronting west on Atlantic avenue, and also the south or Summer street side of the building.

Fig. 2 gives front elevation view of the "New England" building on Summer street, directly opposite the New York & New England R. R. station, adjoining the "Hathaway" building (connected by iron bridges) on the west, and the "Estes Press" building on the east side.

Both buildings named are fitted up with fast running elevators, letter chutes, restaurant, barber shop, and all other modern conveniences.

"NEW ENGLAND" BUILDING, BOSTON.

The "Hathaway" building covers nearly 18,000 square feet, and the "New England" building about 9,000 square feet, and are situated at the intersection of three important thoroughfares, viz.: Summer street, Federal street and Atlantic avenue. The first named building has a frontage of 100 feet on Atlantic avenue and 215 feet on Summer street, and the other building has 98 feet frontage on the last named thoroughfare. The buildings have six floors and basement, respectively, and are built of fire brick, with brown stone foundations and trimmings.

The accompanying diagram sketches (Figs. 3 and 4) show the plan of second and third floors of the "New England" building, and represent the exact location of the several departments of the Thomson-Houston Electric Company, occupying the new quarters.

The following list of electric light companies, electrical enterprises and kindred

interests, occupy offices in the "Hathaway" or "New England" buildings, viz.:

Thomson-Houston Electric Company.
Westinghouse Electric Company.
Westinghouse, Church, Kerr & Company.
Sawyer-Man Electric Company.
Bernstein Electric Company.
Simplex Electric Company.
Waterhouse Electric Company.
Tesla Electric Company.
North American Construction Company.
Thomson-Houston Motor Company.
W. E. Boland Electric Railroad Company.
Consolidated Electric Company.
Drew Electrical Company.
Gethens Electric Company.
Safety Electric Light Company.
American Electric Register Company.
Johnston Electric Train Signal Company.
ELECTRICAL REVIEW.
Electrical Engineer.
Practical Electricity.
National Construction Company.
Union Switch and Signal Company.
Rowell American Switch Company.
National Telephone Manufacturing Company.
Tripp Manufacturing Company.
Electro-Magnetic Clock Company.
Shultz Belting Company.
Laminar Fibre Company.
Evans Friction Cone Company.

Better Than An Electric Light.

"There came about his head a halo as of fire," said the wife of the Rev. Thomas C. McMasters, an aged retired elder of the Methodist Episcopal Church, for the last 20 years a resident of Glens Falls, N. Y.

Mrs. McMasters continuing, stated that her husband came into the house about 8 o'clock in the evening feeling quite well apparently, and sat down on the bed preparatory to retiring, when he was stricken with paralysis, and there came about his head the halo, transfiguring his countenance. It lasted one hour and a half and was like a luminous cloud about the old man's head, extending above him a few inches and reaching from shoulder to shoulder. The bed room was dark at the time and the glory was plainly visible—in fact, it illuminated the room with its radiance.

The venerable wife of the aged minister says the halo has appeared around the head of the minister before. No explanation of the mystery has been offered.

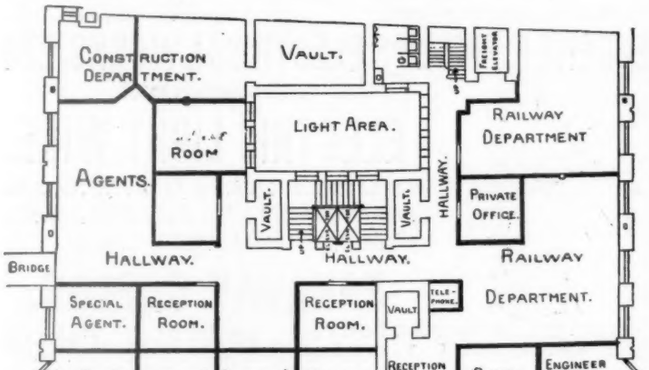


FIG. 3.—DIAGRAM OF SECOND FLOOR, "NEW ENGLAND" BUILDING.

The opening of the Corcoran Art Gallery, Washington, one night last week and the exhibition of the pictures and statuary in a flood of electric light, was a pronounced success and will probably be continued. Here is an example for the trustees of the Metropolitan Museum to emulate.

At a supper given in Baltimore, everything was done by electricity. The pressing of an electric button notified the band to play, the dancers to dance. In the supper room was a track of small brass rails, on which was an electric car or basket about a foot long and 30 inches wide. This car conveyed the viands from the butler's apartment. The butler placed the courses in silver trays upon the car and sent them along the electric railway. The car stopped long enough in front of each plate for each guest to help himself. The car was also supplied with electric bells. Under the tables were music-boxes operated by electricity which played during the supper. Not a drop of coffee or a bit of ice cream was spilled by the electrical waiter.

Killing Rats by Electricity.

A young electrician, of Omaha, has a very ingenious way of killing rats. The rodent is caught in an ordinary oval trap, the bottom of which is covered with tin. One wire connected with a dynamo is fastened to the tin lining of the trap, and another is thrust into the prisoner's cell. The well-known propensity of a caged rat to do battle asserts itself, and he seizes the wire between his teeth. In doing so he makes the mistake of his life. The circuit is completed, his jaws close on the wires with a death grip, and without a squeak, and almost without a quiver, he passes into a state of eternal desuetude.

FIG. 4.—DIAGRAM OF THIRD FLOOR, "NEW ENGLAND" BUILDING.

INTRODUCING ENTIRELY NEW PRINCIPLES.

Pat. Mar. 19, 1889. THE OLD STYLE.

THE ACME LINK BELT

IS MADE ONLY BY THE

Page Belting Company, Concord, N. H.

BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the staple grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.

SUNNY OFFICES
IN THE
"NEW ENGLAND"
AND
"HATHAWAY" BUILDINGS
Foot of Summer St., next to N.E. R.R. Depot.

As a rule, business men spend most of their DAYS in offices which should be SUNNY and PLEASANT to be HEALTHY.

Our rooms face South and are
COOL in SUMMER & WARM in WINTER.
ARTHUR H. TABER, Agt.,
Room 28, 620 ATLANTIC AVE.

The New Metal of the Present, no longer "The Metal of the Future."

ALUMINIUM!
JUST READY.

ALUMINIUM.—Its History, Occurrence, Properties, Metallurgy and Applications, including its Alloys. By Joseph W. Richards, M. A., A. C., Instructor in Metallurgy at the Lehigh University. Second edition, revised and greatly enlarged. Illustrated by 28 engravings and two diagrams. 510 pages. 8vo.

Price, $5.00, by mail, free of postage, to any address in the world.

CONTENTS: CHAPTER I.—History of Aluminium. II.—Occurrence of Aluminium in Nature. III.—Physical Properties of Aluminium. IV.—Chemical Properties of Aluminium. V.—Properties and Preparation of Aluminium Compounds. VI.—Preparation of Aluminium Compounds for Reduction. VII.—The Manufacture of Sodium. VIII.—The Reduction of Aluminium Compounds from the Standpoint of Thermal-Chemistry. IX.—Reduction of Aluminium Compounds by means of Potassium or Sodium. X.—Reduction of Aluminium Compounds by means of Potassium or Sodium (Continued). XI.—Reduction of Aluminium Compounds by the use of Electricity. XII.—Reduction of Aluminium Compounds by other means than Sodium or Electricity. XIII.—Working in Aluminium. XIV.—Alloys of Aluminium. XV.—Aluminium-Copper Alloys. XVI.—Aluminium-Iron Alloys. XVII.—Analysis of Aluminium and Aluminium Alloys. Index.

☞ *A circular of four pages, 4to, showing the full Table of Contents of this thoroughly revised and recast treatise, showing the state of the industry up to 1890, and which has played an important part in the rapid development of this New Metal, will be sent free, and free of postage, to any one in any part of the world who will furnish his address.*

☞ *Our new and revised Catalogue of Practical and Scientific Books, 96 pages, 8vo, and our other Catalogues, the whole covering every branch of science applied to the arts, sent free, and free of postage, to any one in any part of the world who will furnish us with his address.*

HENRY CAREY BAIRD & CO.,
Industrial Publishers, Booksellers and Importers,
810 Walnut St., Philadelphia, Pa., U. S. A.

ELECTRIC CONDENSER WM. MARSHALL, MANUFACTURER. Standards a Specialty
Rooms 2 and 4, University Building, New York.

NON-ELECTRIC
TELEPHONES
THE MOST
Efficient, Desirable and Practicable.
SEND FOR APRIL PRICE LIST.
NATIONAL TEL. MFG. CO., BOSTON.
(Mention this Paper.)

Large Factory Facilities.

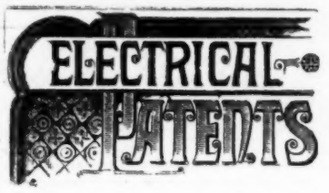
THE OWNERS of a large, modern manufacturing establishment in central New York, have business which occupies the plant for a part of the year only. They would be glad to undertake the manufacture of

Electrical Apparatus, Dynamos, MOTORS

Or any Appliances used in Electric Lighting or for Traction Purposes, for parties who may not have sufficient facilities for present orders. Capacity of the foundry, thirty tons of casting per day, which can be increased if desired. Machine shop well equipped with modern machinery and capacity for employing 150 to 200 men.

This factory is exceptionally well located for receiving supplies and for getting low rates of freight both east and west.

Correspondence addressed to "ELECTRIC," care of Editor ELECTRICAL REVIEW, will receive prompt attention.



INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON APRIL 15, 1890.

425,413 Balanced pen for autographic telegraphs; Harry Etheridge, Pittsburgh, Pa.

425,435 Brush holder for dynamo electric machines or motors; Frederick A. La Roche, Philadelphia, Pa.

425,465 Clutch controller; David R. Steele, Waterloo, N. Y.

425,470 Distribution of electric currents. 425,640 Guard for electric railway trolleys; Elihu Thomson, Lynn, Mass.

425,488 Contact device for electric railways. 425,489 Electric railway contact; Francis O. Blackwell, New York, N. Y.

425,493 Method of transferring batteries; William B. Cleveland, Cleveland, Ohio.

425,507 Electric snap switch; Cornelius J. Hamilton, Philadelphia, Pa.

425,511 Telegraph transmitter; Francis W. Jones, New York, N. Y.

425,513 Insulator; William P. Kookogey, Brooklyn, N. Y.

425,568 Thermo-electric battery; John Edelkamp, New York, N. Y.

425,579 Electric meter; Victor Papp, Paris, France.

425,594 Electric call; Jacob B. Currier, Lowell, Mass.

425,597 Receiving apparatus for cable telegraphy; Patrick B. Delany, New York, N. Y.

425,615 Insulating compound; Adolphus A. Knudson, Brooklyn, N. Y.

425,625 Electric temperature controller; Emer H. Parker, Evanston, Ill.

425,627 Electric car motor; Edgar Peckham, New York, N. Y.

425,630 Electric call. 425,631 Telephone bell and connection; David H. Rice, Lowell, Mass.

425,741 Incandescent lamp socket; James J. Brailey, Harrison, N. J.

425,757 Electric heating apparatus for electric railway systems. 425,866 Electric railway car; Mark W. Dewey, Syracuse, N. Y.

425,760 Measurement of electricity in distribution systems. 425,761 Incandescent lamp. 425,763 Commutator for dynamo electric machines; Thomas A. Edison, Menlo Park, N. J.

425,762 Cut-out for incandescent electric lamps; Thomas A. Edison, Llewellyn Park, N. J.

425,767 Electric railway; Thomas A. Evans, San Francisco, Cal.

425,777 Electric door opener; William L. Godfrey, Brooklyn, N. Y.

425,801 Electric lighting system; Frederick Johnson, Brooklyn, N. Y.

425,818 Secondary battery. 425,819 Secondary battery electrode; James F. McLaughlin, Philadelphia, Pa.

425,840 Phonograph recorder; John H. White, Washington, D. C.

425,853 Electric circuit for telephone purposes; Arthur W. Berne, New Orleans, La.

425,862 Multiple telephony. 425,863 Telephone system; John J. Carty, New York, N. Y.

425,883 Electrically propelled car; Rudolph M. Hunter, Philadelphia, Pa.

425,902 Secondary battery; Gustave Philippart, Paris, France.

425,911 425,912 Electric railway; Richard V. R. Sill, Detroit, Mich.

425,913 Wire conduit; Andrew J. Smith, Soldiers' Home, Kans.

425,917 Electric conductors; Eugenio Tortora, Florence, Italy.

425,923 Method of operating synchronous alternating current motors; Carl Zipernowsky, Buda-Pesth, Maximillian Deri, Vienna.

425,950 Electric railway; Walter H. Knight, New York, N. Y.

425,959 Galvanic battery; Louis M. J. C. Renard, Mendon, near Paris, France.

425,961 Electric conductor; Philip Seubel, New York, N. Y.

425,963 Electric switch; Ernest P. Warner, Chicago, Ill.

425,964 Electric railway system. 425,965 425,966 Electric railway; David G. Weems, Baltimore, Md.

WANTED.—A young man, graduate of Cooper Union, and experienced mechanic, desires a position as assistant to an Electrical Engineer; can also assist at draughting.

S. EDWARDS,
146 Rutledge St., BROOKLYN, N. Y.

R. D. WILSON & CO.,
ELECTRIC SECURITIES
EXCLUSIVELY.
We offer for sale

Local Electric Co.s' Bonds, netting 6%
Mfg. Co.s' Preferred Stocks, " 7%
" " Common Stocks, " 8%

STOCK OF ALL THE ELECTRIC LIGHT AND WELDING MANUFACTURING COMPANIES.
Full information given on all Electric Securities.
Correspondence Invited.
113 DEVONSHIRE ST., Room 21, BOSTON.

GEORGE CUTTER, Electrical Supplies, 80 Adams Street, CHICAGO.
SIMPLEX WIRES. BERNSTEIN LAMPS. BRYANT SWITCHES.

Fuse Wire! Fuse Wire!
Accurately Determined. Carefully Made by a new Process. For Sale by
W. H. GORDON & CO.,
ELECTRIC LIGHT AND POWER SPECIALTIES,
Send for Catalogue. 115 BROADWAY, NEW YORK.

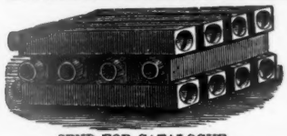
ELECTRICAL CONTRACT WORK.
Detailed Estimates Made and Contracts Taken for Equipment of Complete Steam & Electrical Plants of any system of Arc and Incandescent Lighting, Central Stations and Electric Street Railways operated Overhead, Underground or by Storage Batteries
—ADDRESS—
EUGENE T. LYNCH, Jr., Consulting Engineer, 120 Broadway, New York.

C. M. BLANCHARD, ELECTRICAL CONTRACTOR & ENGINEER
Girard Building, Broad & Chestnut Sts.
PHILADELPHIA.

Daniel W. Baker. Cyrus O. Baker, Jr.
BAKER & CO.,
Importers, Melters and Refiners of
PLATINUM,
408, 410, 412 and 414 N. J. R.R. Ave., NEWARK, N. J.
Platinum in sheet and wire, all sizes, and any degree of hardness. Scrap and native platinum purchased

"Magnetic Vane" Ammeters and Voltmeters.
THE NEW STATION INSTRUMENT — FOR — DIRECT CURRENTS.

ADOPTED AND USED ENTIRELY BY THE Mather Electric Co.
SEND FOR CATALOGUE I-66 OF ELECTRICAL TEST INSTRUMENTS,
MANUFACTURED BY
QUEEN & CO., PHILADELPHIA, PA.

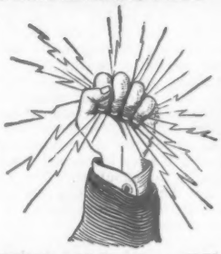

SEND FOR CATALOGUE.
THE WYCKOFF PIPE CO.,
MANUFACTURERS OF
WOODEN PIPES FOR
UNDERGROUND ELECTRICAL WIRES.
We have large works for creosoting Lumber, R. R. Ties, Telegraph Poles, &c., &c.
WILLIAMSPORT, PENN.

NEW YORK ELECTRIC SUPPLY CO.
MANUFACTURERS, IMPORTERS AND DEALERS IN
ELECTRIC SUPPLIES OF EVERY DESCRIPTION,
Electric Light, Telephone and Telegraph Apparatus, Dynamos, Electric Motors, Primary and Storage Batteries, Etc.
No. 94 LIBERTY ST., - NEW YORK

SILKS. Full assortment of different sizes and qualities on BRAIDER SPOOLS, ready for the machines, in Red, Yellow and Green. Other colors to order. Send for Sample and Prices.
WM. MACFARLANE, & CO., 81 Grand Street, New York.
Telephone No. 971 Spring. Mill, Bergen Point, N. J.

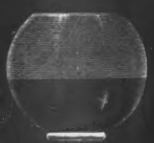
THE CLARK
ARC LIGHTING SYSTEM
Is the Safest and Most Economical in the United States.
Manufactured by the CLARK ELECTRIC CO., 192 Broadway, N. Y.

THE HORIZONTAL
Drilling AND Boring Machine
IS A SPECIAL TOOL FOR BORING THE
FIELDS and BEARINGS of DYNAMOS and MOTORS.
Its Product Exceeds that of Three Boring Lathes.
Send for particulars to the Newark Machine Tool Works, NEWARK, N. J.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec. & Electrician.
AMERICAN ELECTRICAL WORKS,

Manufacturers of Patent Finished
ELECTRIC LIGHT WIRE,
MAGNET WIRE, OFFICE & ANNUNCIATOR WIRE.
RUBBER COVERED WIRE, LEAD ENCASED WIRE,
TELEPHONE & INCANDESCENT CORDS.
FARADAY CABLES.
Office and Factory, 67 STEWART STREET., PROVIDENCE, R. I.
New York Office, 18 Cortlandt St., P. C. Ackerman, Agt.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y-Treas.
EUGENE F. PHILLIPS ELECTRICAL WORKS, LTD.

Manufacturers of
ELECTRIC LIGHT WIRE,
MAGNET WIRE, OFFICE & ANNUNCIATOR WIRE,
RUBBER COVERED WIRE, LEAD ENCASED WIRE,
TELEPHONE & INCANDESCENT CORDS.
FARADAY CABLES.
OFFICE AND FACTORY, St. Gabriel Locks, MONTREAL, CANADA.

PHŒNIX GLASS CO
OF PITTSBURGH, PA.
MANUFACTURERS OF A FULL LINE OF
ELECTRIC LIGHT
GLOBES  SHADES
BOTH ARC AND INCANDESCENT.
RICH CUT, OPAL, CLEAR, ETCHED, ROUGHED, ETC.
ADAPTED TO ALL SYSTEMS.
729 BROADWAY, NEW YORK.
(CORNER WAVERLY PLACE), AND
43 SIXTH AVE., PITTSBURGH, PA.

HIGHEST AWARD, PARIS EXPOSITION 1889.

THE ONLY Gold Medal AWARDED FOR Electric Batteries

TRADE GONDA MARK.
The Standard Open Circuit Batteries of the World, AND THE BEST.
THE LECLANCHÉ BATTERY CO.,
149 West 18th Street, New York.

WESTERN ELECTRIC COMPANY,

CHICAGO. **NEW YORK.**

MANUFACTURERS OF

Weatherproof and Underwriter's Wire

AND WESTERN AGENTS FOR

A. G. DAY'S KERITE WIRE.

THE EDDY ELECTRIC M'F'G CO.

MANUFACTURERS OF

AUTOMATIC ELECTRIC MOTORS,

In all sizes, from 1-2 H. P. upward; High Efficiency; Perfect Regulation; Superior Workmanship; Ease of Management; Remarkable Simplicity, etc., etc.

DYNAMO ELECTRIC MACHINES,

For Electro-Plating, Electrotyping, Copper Refining, Etc. No Reversing. No Water. No Noise. No Spark.

SATISFACTION GUARANTEED.

THE EDDY ELECTRIC M'F'G CO., WINDSOR, CONN.

NEW YORK, 33 Church St., BOSTON, 111 Arch St., PHILADELPHIA, 506 Commerce St., KANSAS CITY, Rialto Building, NEW ORLEANS, 106 Carondelet St.

A MAP

OF THE

UNITED STATES.

A large, handsome Map of the United States, showing North and South Dakota, mounted and suitable for office or home use, and issued by the

BURLINGTON ROUTE,

will be furnished responsible parties free on application to the undersigned.

PLAYING CARDS.

For **10** cents, either in postage or by applying at Room 12, C., B. & Q. R. R. General Office, corner of Adams and Franklin streets, Chicago, you can obtain a pack of best quality Playing Cards.

P. S. EUSTIS,
Genl. Pass. & Ticket Agent, C., B. & Q. R. R.,
CHICAGO, ILL.

FOR SALE.

1-2 PRICE.

NEW ENGINES.

Two 40 H.P. Armington & Sims' Automatic Engines.
One 50 H.P. Russell Automatic Engine.

A. L. IDE & SON,
SPRINGFIELD, ILL.

ELECTRIC LIGHT TOWERS

FOR SALE.—We have for sale eight (8) one hundred and fifty (150) feet, and two (2) one hundred and seventy-five (175) feet tubular Iron Towers with Elevators, all complete, and in good order.

We will send them as they stand, or F. O. B., Savannah. Address

The Brush Electric Light & Power Co.,
Savannah, Ga.

ELECTRICAL MEASUREMENT

Instruments and Batteries of the Very Highest Grade.

Precision and Constancy, Quality and Finish the Best in the World.

Catalogue of Standard Test Instruments furnished upon application.

THE E. S. GREELEY & CO.,
5 AND 7 DEY ST., NEW YORK.

WELLINGTON

Belt Holder

The simplest, cheapest and handiest device in existence for shifting Dynamo Belts. Please write for circulars to

W. R. SANTLEY & CO.
WELLINGTON, O.

ELECTRICAL REVIEW BINDER FREE

The Electrical Review will send a FREE BINDER to every subscriber in the U. S. and Canada who sends $3.00 for a year's subscription.

Address,
Electrical Review, 13 Park Row, N.Y.

ELECTRICAL DICTIONARY

By EDWIN J. HOUSTON, A. M.

655 Pages; 396 Illustrations; Cloth.

Gives a clear definition of the word, term or phrase, and a brief statement of the principles of science involved in the definition, with illustrations where necessary.

Sent, postage prepaid, to any address on receipt of **$2.50.**

ELECTRICAL REVIEW,
13 PARK ROW,
P. O. Box 3329. New York.

THE E. S. GREELEY & CO.,

Nos. 5 & 7 Dey St., New York

Manufacturers and Importers of and Dealers in

Telegraph, Telephone
— AND —
Electric Light Supplies

AGENTS FOR

Cleveland Arc Light Cut Outs & Gang Switches

Cleats, Rosettes, Moulding, Pins, Cross-Arms, Brackets. Insulating Tapes.

Rubber, Porcelain and Glass Insulators

WIRES OF ALL KINDS.

Silk & Cotton Covered Flexible Conducting Cord of various sizes for Incandescent Lighting.

Spikes, Pole Steps, Lag Screws, Drive Screws. Turn Buckles. Etc.

Just Issued,

FOR 1890,

THE RAILROAD, TELEGRAPH & STEAMSHIP BUILDERS' DIRECTORY.

A United States Business Directory containing the names of manufacturers and dealers, covering all articles, devices and materials used in the construction and operation of **Railroad, Telegraph, Steamship, Heat and Power, Electric Light Co.s'** etc., including dealers in **Lumber, Iron and Steel. Locomotive and Car Builders, Railroad, Bridge and other Contractors; Electric Light, Telegraph and Telephone Co.'s; Ship Builders and Materials.**

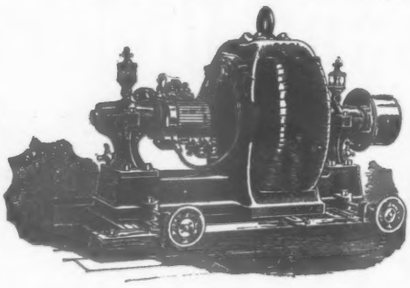
Including a list of every Railroad in the United States, Canada and Mexico, giving length in miles, Rolling Stock and Officials in charge of ordering and **Purchasing Supplies;** together with valuable tables useful in **Railroad Construction.**

Price, $2.50.

"C. & C." ELECTRIC MOTOR COMPANY,

402 & 404 Greenwich Street, New York.

ALL STANDARD SIZES
— OF —
Electric Motors
From 1/8 H. P. to 50 H. P.



OVER 6,000 NOW IN USE
In the UNITED STATES,

Running Sewing Machines, Elevators, Printing Presses, Ventilating Fans, Blowers, Coffee Mills, Polishing and Grinding Tools, etc.

NEW ENGLAND OFFICE: 148 High Street, cor. Oliver, Boston.
PHILADELPHIA OFFICE: 301 Arch Street.
CHICAGO OFFICE: Phenix Building.
CINCINNATI OFFICE: Smith Building.

THE BUTLER HARD RUBBER CO.,

No. 33 MERCER STREET, NEW YORK,

Manufacturers of Hard Rubber Goods of Every Description Including the Celebrated

HARD RUBBER BATTERY CELLS

MANUFACTURED UNDER KIEL'S PATENTS FOR

STORAGE AND PRIMARY BATTERIES.

CHEAPEST AND BEST CELLS IN THE MARKET.

Also SHEET, ROD AND TUBING (Kiel's Patent), for **ELECTRICAL PURPOSES** at **REDUCED PRICES.** Standard quality Sheet, Rod, Tubing, Insulator Hooks, Key Knobs, Switch Handles, Telephone Receivers and Battery Syringes constantly on hand. Hard Rubber Specialties of all kinds made to order. Send for Prices and Estimates.

For Sale by CENTRAL ELECTRIC CO., CHICAGO, ILL.

THE NEW
EDISON-LALANDE BATTERY.

MANUFACTURED UNDER AUTHORITY OF

THOMAS A. EDISON.

Primary Batteries for Telegraph "Mains" and "Locals," Electro-Motors, Electro-Plating, Telephone Transmitters, Electro-Medical Instruments, Annunciators and Burglar Alarms, and all Classes of Closed and Open Circuit Work.

FURTHER PARTICULARS AND INFORMATION FURNISHED UPON APPLICATION.

ADDRESS:

EDISON MANUFACTURING COMPANY,

JAMES F. KELLY, General Sales Agent,

19 Dey Street, New York.

THE

UNITED STATES ELECTRIC LIGHTING CO.

(WESTINGHOUSE ELECTRIC CO., Lessees.)

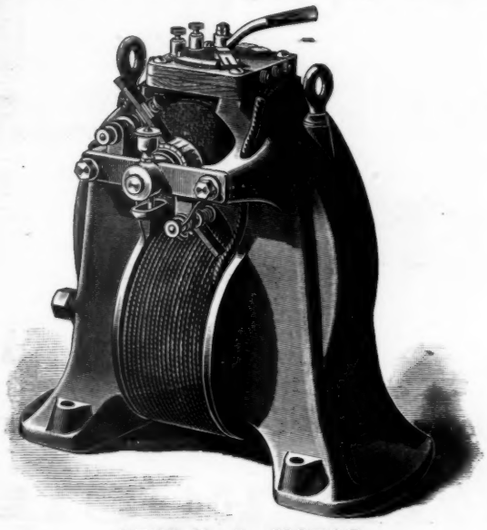
ARC AND INCANDESCENT

ISOLATED ELECTRIC LIGHT PLANTS.

AUTOMATIC DYNAMOS. PERFECT DEVICES.

More than 1,000 Plants in operation in Mills, Hotels, Office Buildings, Theatres, Etc.

ELECTRIC MOTORS and GENERATORS.



NEW U. S. MOTOR.

Direct Current Generators and Motors for all purposes. 1-8 horse-power up to any power desired, and of any required E. M. F. Superior in Design and Workmanship, and Unequalled in Efficiency.

Send for New U. S. Catalogue on Incandescent Lighting and Motors.

GENERAL OFFICES:

EQUITABLE BUILDING, 120 Broadway, N. Y.

THE

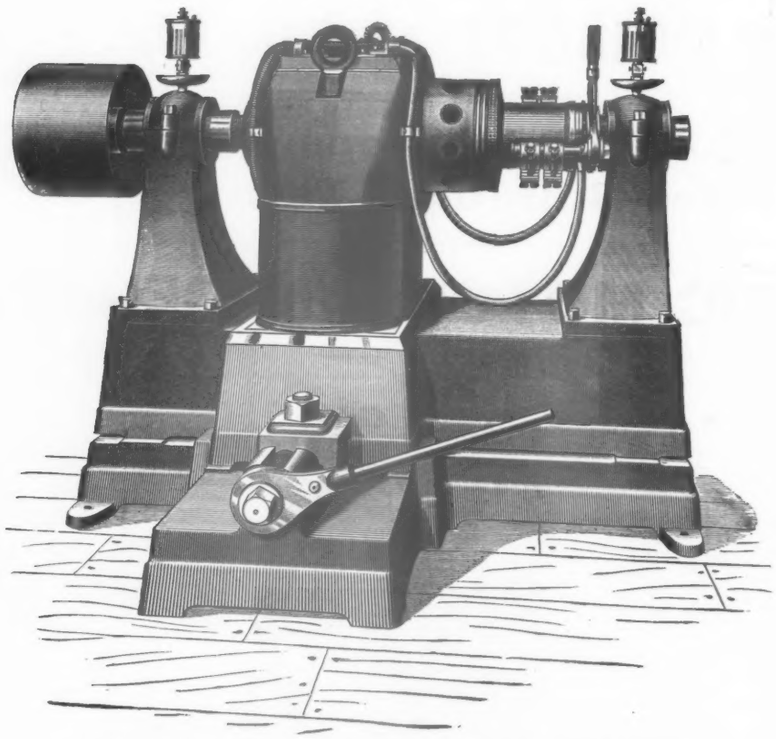
Thomson-Houston Electric Co.,

MANUFACTURERS OF

Dynamos, Lamps and all Necessary Appliances

FOR

DIRECT CURRENT INCANDESCENT LIGHTING.



40,000 WATT MOTOR TYPE DYNAMO.

COMPLETE EQUIPMENTS

FOR

Central Stations and Isolated Plants.

THE THOMSON-HOUSTON ELECTRIC COMPANY.

620 Atlantic Avenue, Boston, Mass.
Wall and Loyd Streets, Atlanta, Ga.
1110 Noble Street, Philadelphia, Pa.
215 West Fourth Street, Cincinnati, O.
503 Delaware Street, Kansas City, Mo.
148 Michigan Avenue, Chicago, Ill.
115 Broadway, New York City.
234 Montgomery Street, San Francisco, Cal.
403 & 405 Sibley Street, St. Paul, Minn.
1333 F Street, Washington, D. C.

OKONITE
TRADE MARK.
WIRES, CABLES, TAPE AND CORD.

LOOK TO US
FOR ELECTRICAL SUPPLIES
OF EVERY DESCRIPTION.
We Guarantee Prompt Shipments, Low Prices, and the Best of Goods.

INCANDESCENT
LAMPS
—AND—
ALL KINDS OF FITTINGS.

Southern Electrical Supply Company
823 LOCUST ST., between 8th and 9th Sts.
WRITE FOR CATALOGUE. **ST. LOUIS, MO**

P. MINTURN SMITH - President.
WILLIAM D. PERRY - Vice Pres't.
G. G. FRELINGHUYSEN - Secretary
CHARLES TREMAINE - Treasurer
JAMES W. EASTON — Electrician

THE EASTON ELECTRIC Co.
ELECTRICAL APPARATUS FOR ARC AND INCANDESCENT LIGHTING
Office 45 BROADWAY
New York.

Style "C" Hotel Annunciator,
WITH RETURN CALL.

SEND BUSINESS CARD FOR CATALOGUE AND DISCOUNT SHEET.

FRANKLIN S. CARTER. CHAS. M. WILKINS. E. WARD WILKINS.
TRADING AS
PARTRICK & CARTER,
MANUFACTURERS AND DEALERS IN ELECTRICAL SUPPLIES.
Sole Proprietors of the Patent Needle Annunciators,
114 SO. SECOND ST., PHILADELPHIA, PA.
Established 1867.

WRITE For the Electrical Review's *New Catalogue* of all Electrical and Scientific Books.
18 PARK ROW, NEW YORK.

THE EMPIRE CITY ELECTRIC Co.
HELMET BRAND. WATER PROOF. WEATHER PROOF.
INSULATED WIRE.
Telegraph, Telephone & Electric Light WIRES AND CABLES.
HARDTMUTH EMPIRE CARBONS.
HARD AND SOFT CORED.
Mason Primary Batteries.
HOUSE WORK MATERIAL.
Batteries, Wire, Bells, Push-buttons, Flexible Cord, Burglar Alarms, Etc., Etc.
ELECTRIC LIGHT MATERIAL.
Poles, Cross-arms, Pins, Insulators, Brackets, Switches, Cut-outs, Lamps, Fixtures, Shades, Shade-holders, Etc., Etc.
ALL KINDS OF
ELECTRICAL SUPPLIES
Send for Wire Price-List and Catalogue to
The Empire City Electric Co., 15 Dey Street, N. Y.

INTERIOR CONDUIT AND INSULATION COMPANY.

A New and Improved Method of Fitting Buildings with Insulated Tube Conduits to receive Wire for any Electrical System.

COMBINING ADVANTAGES OF

Safety, Durability, Economy, Accessibility, Convenience.

Samples, Price Lists, Catalogues and Instructions, Mailed on Application.

ADDRESS

INTERIOR CONDUIT AND INSULATION COMPANY,
16 and 18 BROAD STREET, NEW YORK.

A NEW BOOK!

WILL BE ISSUED AS SOON AS THE REVISIONARY WORK IS COMPLETED.

Electric Law,

EDITED BY FRED H WHIPPLE.

Being a COMPILATION of all LAWS upon the STATUTE BOOKS of the different States, relating to ELECTRICITY; OPINIONS of the HIGHEST AUTHORITIES where these Laws have been SUBJECTS OF LITIGATION;

PROVISIONS of all MUNICIPAL Electric ORDINANCES and TERMS of all Electric FRANCHISES, whether for LIGHT or POWER.

With ANNOTATIONS, COMPARISONS, EFFECTS, Etc.

A BOOK, THE IMPORTANCE OF WHICH TO THE ELECTRIC WORLD CANNOT BE ESTIMATED.

SEND IN YOUR ORDER. Price, handsomely printed and bound, TEN DOLLARS.

"The Electric Railway" } Paper, $1.00
"Municipal Lighting" } Leather, 2.00

WHIPPLE'S NATIONAL ELECTRICAL DIRECTORY,
IN CLOTH, $10.00.

WHIPPLE'S ELECTRIC REPORTS,

PUBLISHED MONTHLY. *$3.00 PER YEAR.*

ADDRESS

The FRED H. WHIPPLE CO., DETROIT, MICH.

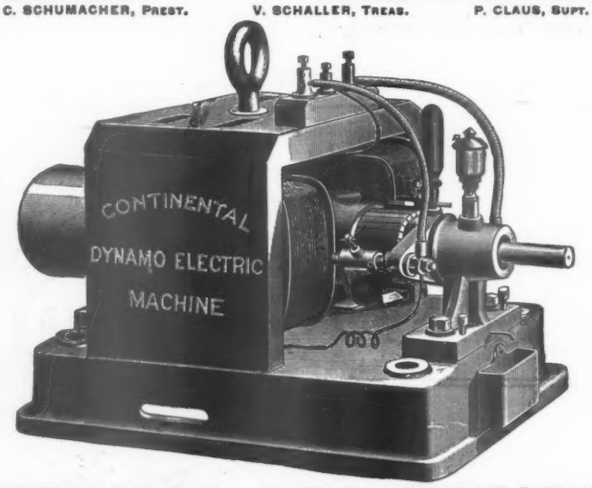
Or any Electrical Journal and the Leading Book Stores.

New York Office: - - - 18 Cortlandt Street.

WRITE For the Electrical Review's *New Catalogue* of all Electrical and Scientific Books.
18 PARK ROW, NEW YORK.

CONTINENTAL DYNAMO COMPANY,
NEW YORK.

OFFICE: 63 BROADWAY. C. SCHUMACHER, PRES'T.
162 AND 164 W. 27th ST. V. SCHALLER, TREAS.
FACTORY: P. CLAUS, SUPT.

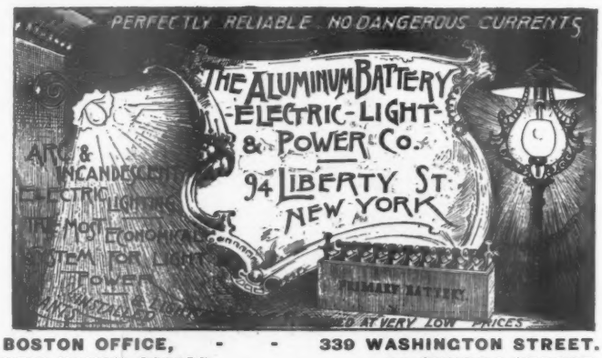


DYNAMOS AND MOTORS.

ADVANTAGES CLAIMED:

Simplicity and Solidity of Construction. Compactness and Small Size. High Efficiency and No Waste of Power. No Magnetism Outside. Accessibility of the Different Parts. Lower Cost than all other known Dynamos.

St. Paul, Minn., C. J. Thomson, Agt., 100 East Fourth Street.



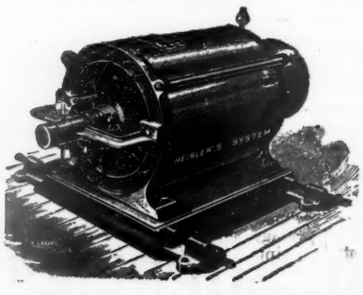
BOSTON OFFICE, - - 339 WASHINGTON STREET.
NEW HAVEN OFFICE, - - - 94 CHURCH STREET.

THE

HEISLER PATENT LONG DISTANCE INCANDESCENT ELECTRIC LIGHT SYSTEM

Awarded the Highest Distinction, a Gold Medal, at the Paris Exposition, 1889.

UNEQUALLED FOR DISTRIBUTION OVER WIDE AREAS.



Specially adapted for Street, Commercial and Domestic Illumination from Central Stations. Plant may be located where Power can be secured Cheapest, even if Miles Distant from the Lighting. Safety, Reliability, and Financial Success fully Demonstrated. Plan of Wiring the Simplest, Cheapest, and Most Efficient. Strictly Series. Lamps, 10 to 100 Candle Power. Long Life without Blackening. Dynamo Self-Contained and Automatic.

SEND FOR CIRCULARS. CORRESPONDENCE SOLICITED.

HEISLER ELECTRIC LIGHT CO., 809 to 817 South Seventh St., ST. LOUIS, MO.

TELEPHONES FOR EXPORT!!!

FOR SOUTH AMERICA, CENTRAL AMERICA AND WEST INDIES.

Genuine "BELL" Telephones, "BLAKE" Transmitters and Magneto Call Bells, or CHEAPER European made Instruments at Lowest Prices.

Those who care for PRICE ONLY send for the latter.

Those who consider durability and good service use the former.

Send for New Circular and Price List.

ALL EXPORT ORDERS MUST BE ADDRESSED TO

THE TROPICAL AMERICAN TELEPHONE CO., Ltd.,

95 MILK STREET, BOSTON. 18 CORTLANDT STREET, NEW YORK.

CONRAD N. JORDAN, President. E. COGORZA, Vice-Prest. & Treas. JAMES DUNNE, Secretary. J. R. BURDICK, Manager.

THE TRINIDAD-HEIMANN INSULATED WIRE CO.,

OFFICE, 49 LIBERTY STREET, NEW YORK. WORKS, HARRISON, N. J.

THE CELEBRATED TRINIDAD LINE WIRE. THE HEIMANN FIREPROOF INSULATED WIRE.

House Wire, Underground and Submarine Cables, and Solid System of Underground Wire, Manufactured by this Company.

LIST OF DYNAMOS IN STOCK.

Designation of Machine.	No. Lights 2,000 c. p. 10 amp. X	No. Lights 1,600 c. p. 8 amp. Y	No. Lights 1,200 c. p. 6 amp. Z	No. Lights 800 c. p. 4 amp.	Horse-Power at Pulley of Dynamo.	Width of Single Belt in Inches.	Belt Speed Required.	Weight of Dynamo.
C	8	.....	.....	.....	6.5	1¼	5,000 FEET PER MINUTE.	530
C	.....	10	.....	.....	6.3	1½		530
C	.....	.....	.....	25	8.0	2		530
E	16	.....	.....	.....	12.0	2½		780
E	.....	20	.....	.....	12.5	2½		780
E	.....	.....	26	.....	13.0	2½		780
G	20	.....	.....	.....	15.0	3		900
G	.....	25	.....	.....	15.6	3		900
G	.....	.....	32	.....	15.0	3		900
G	.....	.....	.....	50	16.0	3		900
I	28	.....	.....	.....	21.0	4½		1,300

LIST OF DYNAMOS IN STOCK.

Designation of Machine.	No. Lights 2,000 c. p. 10 amp. X	No. Lights 1,600 c. p. 8 amp. Y	No. Lights 1,200 c. p. 6 amp. Z	No. Lights 800 c. p. 4 amp.	Horse-Power at Pulley of Dynamo.	Width of Single Belt in Inches.	Belt Speed Required.	Weight of Dynamo.
G	.....	35	.....	.....	21.0	4	5,000 FEET PER MINUTE.	1,360
G	.....	.....	45	.....	21.0	4		1,360
H	.....	.....	.....	70	21.0	4½		1,360
H	.....	40	.....	.....	29.7	6		1,750
H	.....	.....	.....	.....	30.0	6		1,750
I	.....	50	64	.....	29.5	6		1,750
I	52	.....	.....	.....	38.0	8		2,290
I	.....	65	.....	.....	38.6	8		2,290
J	.....	.....	83	.....	38.0	8		2,290
J	64	.....	.....	.....	46.5	10		2,770
K	.....	80	.....	.....	47.1	10		2,770
K	75	.....	.....	.....	52.5	12		3,200

THE NATIONAL CARBON CO.

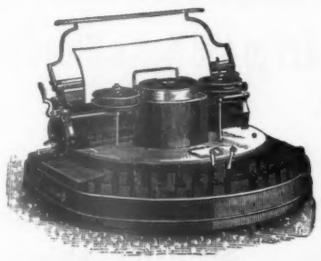
CLEVELAND, OHIO.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

SUBSCRIBE NOW FOR THE ELECTRICAL REVIEW.

"HAMMOND"



TYPEWRITER

SPEED UNEXCELLED.

Highest Awards, New York, London, Paris, Brussels, Boston, New Orleans, Etc.

THE HAMMOND TYPEWRITER CO.,

447-449 East 52d St., New York.

77 Nassau St., New York, 209 N. 8th St., St. Louis,
138 La Salle St., Chicago, 42 W. 4th St., Cincinnati,
300 Washington St., Boston, 116 S. 6th St., Philadelphia.

Vol. VI. 113 Liberty St., New York. Monthly, $2.00 Per Year.

THE STREET RAILWAY JOURNAL, 113 Liberty Street, NEW YORK.

CONTENTS.

Each issue contains 180 pages or more, including 40 to 60 pages of reading matter and illustrations.

A Directory of Street Railways in the United States and Canada.

A Directory of Manufacturers of street railway appliances and materials.

Is the Best Advertising Medium through which to reach Street Railways.

PENNSYLVANIA RAILROAD.

THE GREAT TRUNK LINE OF THE UNITED STATES.

The Standard Railway of America. Double Track. Steel Rails. Stone Ballast and Stone Bridges. Protected Throughout by the Interlocking Switch and Block-Signal System.

THE SCENIC LINE TO THE WEST AND THE ROUTE OF THE CELEBRATED PENNSYLVANIA LIMITED,

The Ideal Train of the Nineteenth Century,

WHICH LEAVES NEW YORK DAILY AT 10 A. M. FOR CINCINNATI AND CHICAGO.

Five Fast Express Trains Daily between New York & Western Points.

Twelve Fast Express Trains between New York, Baltimore, Washington & Southern Points.

FINEST EQUIPMENT, UNEQUALLED SPEED, AND GREATEST COMFORT.

☞ *Through Parlor, Sleeping and Dining Cars on all Express Trains.*

CHARLES E. PUGH, Gen. Man. J. R. WOOD, Gen. Pass. Agent.
SAMUEL CARPENTER, Asst. Pass. Agent, 849 Broadway, New York.

Electric Light Installations

AND THE

Management of Accumulators.

BY SIR DAVID SALOMONS.

Fifth Edition. Revised and Enlarged.
WITH NUMEROUS ILLUSTRATIONS.

A General Survey of the Practice of Electric Lighting and the Management of Accumulators, with recommendations to assist in obtaining successful results.

PART I.

Description of Cells, Mode of Employment, Setting Them Up, and Accumulator House, Charging, Discharging and Failures; their causes and remedies.

PART II.

Engines, Dynamos, Motors, Switchboards, Switches, Instruments, Lamps and Wiring, Rules for Prevention of Fire Risks, Action of Cells with Dynamo, Methods of Working and Governing, Alternating Currents, Testing and Estimates.

PRICE, $1.50.

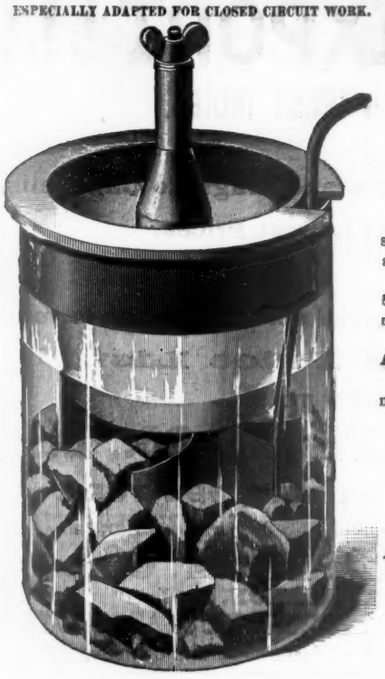
Copies of this book will be mailed, postage prepaid, to any address, on receipt of price.

Address

ELECTRICAL REVIEW,

P. O. Box 3329. 18 Park Row, N. Y.

ESPECIALLY ADAPTED FOR CLOSED CIRCUIT WORK.



GETHINS IMPROVED GRAVITY BATTERY,

MANUFACTURED BY THE

Gethins Electrical Manufacturing Company,

620 ATLANTIC AVE., BOSTON, MASS.

This Battery is a combination of the Daniell and Gravity Cells, and is much superior to either in economy in consumption of Zinc and Vitriol, great durability, uniform constancy and entire freedom from overflow of copper, thus rendering it a clean Battery at all times.

The Battery runs from 12 to 15 months **without any attention** except a renewal of evaporation, and saves **50 Per Cent.** in the expense of material. Its remarkable constancy is shown by a test covering a period of over 12 months, where on a constantly closed circuit it showed **no variation** in current.

The Gethins Battery is especially adapted for **Telegraph** and **Signal** work of all kinds, and on account of its **Absolute Constancy,** is especially adapted for Railway Signal Work.

This Battery has been adopted by the city of Boston for Fire and Police Telegraph Departments, there being in use now in that city alone **over 2,000 Cells.** Shipments are constantly being made to all parts of the country.

Battery, consisting of Glass Jar, Copper, Zinc and Porous Cup, $1.25 each.
Battery, without Glass Jar, - - - - - - 1.00 each.

DISCOUNT TO THE TRADE.

Quantity of Chemicals required for setting up Battery, as follows:
4 lbs. Blue Vitriol. 1 oz. Sulphate of Zinc. 8 oz. Mercury.

WE CAN FURNISH SUPPLIES, IF DESIRED, AT MARKET PRICES.

Address, GETHINS ELECTRICAL MFG. CO.,
620 Atlantic Avenue, Boston, Mass.

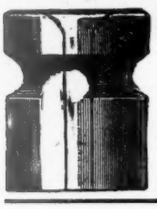
W. R. ORSTRANDER & CO.
195 & 197 FULTON ST., NEW YORK.
Manufacturers of
SPEAKING TUBES, WHISTLES, ANNUNCIATORS,
Electric & Mechanical Bells,
FACTORY,
De Kalb Avenue,
BROOKLYN.
Send for Illustrated Catalogue.

BALL AUTOMATIC CUT OFF ENGINE
MADE ONLY BY
THE BALL ENGINE CO
ERIE PA.

Eastern Agents, C. R. Vincent & Co., Room 16, 15 Cordlandt St., New York.

THE LEHIGH VALLEY
CREOSOTING CO.
WORKS, PERTH AMBOY, N. J.
Office, Foot of Washington Street, JERSEY CITY, N. J.
Creosoted Lumber, Underground Conduits, Telegraph Poles, Piling and Ties Furnished.

HYDRAULIC PRESSES.
ALL VARIETIES.
PUMPS, VALVES, GAUGES AND FITTINGS,
PUNCHES, SHEARS, BUFFING MACHINERY, &c.
WATSON & STILLMAN,
210 East 43d Street, New York City.
Special Attention to Electrical Work.



Porcelain Electrical Supplies and Specialties,
MANUFACTURED BY
EMPIRE CHINA WORKS,
144 & 156 Greene St., GREENPOINT, BROOKLYN, E. D., N. Y.
Our Ware is HARD PORCELAIN, the BODY and GLAZE IDENTICAL, and GUARANTEED NON-CONDUCTIVE for all ELECTRICAL PURPOSES.

THE
American Bell Telephone Company,

95 MILK ST., BOSTON, MASS.

This Company owns the Letters Patent granted to Alexander Graham Bell, March 7th, 1876, No. 174,465, and January 30, 1877, No. 186,787.

The Transmission of Speech by all known forms of ELECTRIC SPEAKING TELEPHONES infringes the right secured to this Company by the above patents, and renders each individual user of telephones, not furnished by it or its licensees, responsible for such unlawful use, and all the consequences thereof and liable to suit therefor.

THE
Horn, Brannen & Forsythe
Manufacturing Co.
(INCORPORATED.)

Designers and Manufacturers of
Gas & Combination Fixtures,
AND
ELECTROLIERS,
427 to 433 North Broad St.
PHILADELPHIA.

CORRESPONDENCE SOLICITED.

DURABLE! EFFICIENT! ECONOMICAL! CONVENIENT!

FOR STATIONARY OR RAILWAY WORK, FOR MINING OR ENGINEERING OPERATIONS,

The Sprague Electric Motors are Unexcelled.

Small Fan and Pump Outfits for Arc and Incandescent Circuits. Sole Agents for the Crocker-Wheeler Constant Current Motors.

SPRAGUE ELECTRIC RAILWAY & MOTOR CO.,
Agencies in all Large Cities. 16 and 18 Broad Street, New York.

EXCELSIOR ELECTRIC CO.,

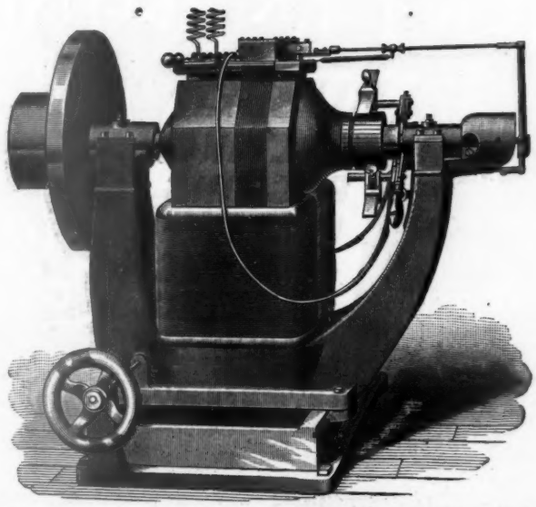
WILLIAM HOCHHAUSEN, ELECTRICIAN.

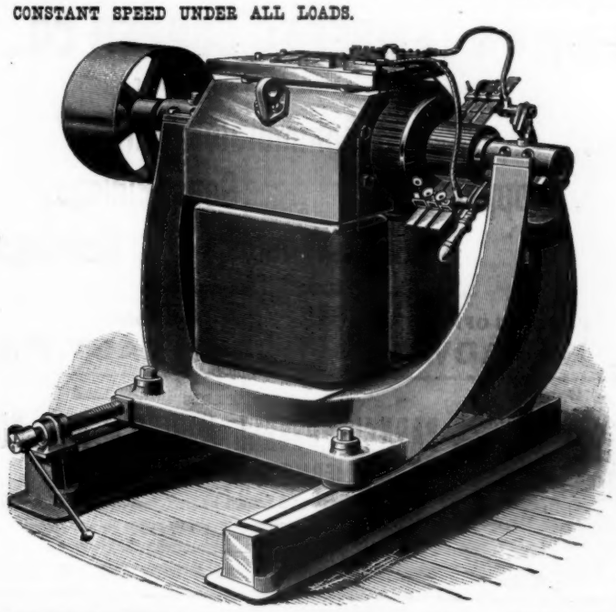
MOTORS

FOR ARC AND INCANDESCENT CIRCUITS.

WOUND FOR ANY CURRENT. PERFECT AUTOMATIC REGULATION

HIGHLY EFFICIENT AND ECONOMICAL. CONSTANT SPEED UNDER ALL LOADS.





OFFICE, 115 BROADWAY, N. Y. WESTERN OFFICE, 11 E. ADAMS ST., CHICAGO.

HOLMES, BOOTH & HAYDENS,

MANUFACTURERS OF

BARE AND INSULATED WIRE,

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO.,

FACTORIES: WATERBURY, CONN.

NEW YORK OFFICE, 25 Park Place,

THOS. L. SCOVILL, NEW YORK AGENT.

DAFT ELECTRIC LIGHT COMPANY,

EXECUTIVE OFFICES, 115 BROADWAY, NEW YORK.

AGENCIES:

13 South 4th St., Philadelphia. 119 La Salle Street, Chicago.

Electric Railways and Power Stations,

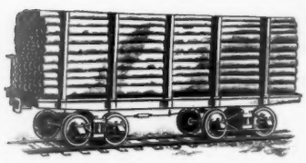
STATIONARY MOTORS, STORAGE BATTERIES.

DYNAMOS, 1 to 250 H. P. MOTORS, ⅛ to 100 H. P.

WORKS, JERSEY CITY, N. J.

STEVENS & BABCOCK,

EAST SAGINAW, MICH.



Electric Light Poles

A SPECIALTY.

ASK FOR PRICES.

Delivered any part of the United States.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of PURE COPPER Tempered for

Brush Copper, Commutator Bars,
Copper Wire, Gear Pinions,
Trolley. Wheels, Bearings.

EASTERN OFFICE: 35 BROADWAY. | FACTORY: NORTH EAST, PA.

SUNLIGHT CARBONS

THE PARKER-RUSSELL MINING & MFG. CO.

MERMOD-JACCARD BUILDING,

Cor. Broadway and Locust St. Rooms 307 and 308.

ST. LOUIS.

UNIFORM IN QUALITY, LONG LIFE AND GOOD LIGHT

Washburn & Moen Mfg. Co.

WORCESTER, MASS.

MAKERS OF

IRON AND STEEL

MANUFACTURERS OF

Iron and Copper Wire for Electrical Purposes.

PATENT GALVANIZED TELEGRAPH & TELEPHONE WIRE,

In Long Lengths, Galvanized by our Patent Continuous Process.

The Standard with all Telegraph and Telephone Companies.

Since the first introduction of the Electric Telegraph Service, our patent wire, expressly manufactured for electric purposes, has filled every requisition as regards strength, evenness of quality, and conductive capacity.

Send for Price Lists and descriptive pamphlets, and "Hand-book of Wire in Electric Service." Sent free on application.

New York Warehouse, 18 CLIFF STREET.

Chicago Warehouse, 107 & 109 LAKE ST.

F. M. RICKETTS COMPANY, Limited,

Layers and Repairers of

Submarine Cables.

14 CORTLANDT STREET, - NEW YORK CITY.

J. A. SEELY, President. W. G. SELLERS, Gen. Manager.

All GENUINE INGOTS & MANUFACTURES BEAR OUR REG. TRADE MARKS

Phosphor Bronze

PHOSPHOR-BRONZE

INGOTS, CASTINGS & MANUFACTURES.

THE PHOSPHOR BRONZE SMELTING CO. LIMITED

512 ARCH ST. PHILADELPHIA PA. U.S.A.

ORIGINAL MANUFACTURERS OF PHOSPHOR-BRONZE IN THE UNITED STATES AND OWNERS OF THE U.S. PATENTS.

NEW YORK BELTING AND PACKING CO.

LARGEST BELTS IN THE WORLD.

RUBBER BELTING, PACKING, HOSE,— —MATS, MATTING, STAIR-TREADS.

15 PARK ROW, NEW YORK.

(OPPOSITE ASTOR HOUSE.)

J. H. CHEEVER TREAS. J. D. CHEEVER DEP'Y. TREAS.

ROYCE & MAREAN,

DEALERS IN

ELECTRICAL APPARATUS

Telegraph and Telephone Supplies,

No. 1408 Penna. Avenue,

Opp. Willard's Hotel. WASHINGTON, D. C.

SperryElectric Company,

Factory 195-207 Canal Street, Chicago, Ill.

MANUFACTURERS OF THE

Improved Sperry High and Low Tension Systems of Arc Lighting,

Claiming the Highest Efficiency, Reliability and Durability. Perfect Regulation.

Corliss Engines

Of the highest type, in all sizes, are made by

The Lane & Bodley Co.

CINCINNATI, O.

The merits of their engines are described in an illustrated pamphlet, which will be sent to any one interested.

S. Y. L'HOMMEDIEU & CO., Eastern Agents, 65 Reade St., N. Y.

S. Y. L'HOMMEDIEU & CO., Eastern Agents, 65 Reade St., N.Y.

FARADAY CARBON CO.,

ELECTRIC LIGHT CARBONS, PITTSBURGH, PA.

COMPOUND. CONDENSING OR NON-CONDENSING.
16 Sizes, 5 to 500 H. P. Not yet equaled by any form of Engine for HIGH FUEL DUTY AND SIMPLICITY.

STANDARD. 13 Sizes in Stock. 5 to 250 H. P.
3,000 in use in all parts of the Civilized World.

JUNIOR. 6 Sizes in Stock, 5 to 50 H. P.
AN AUTOMATIC ENGINE CHEAPER THAN A SLIDE VALVE.
Well Built. Economical. Reliable. Over 300 sold the first year.

All the above built strictly to Gauge with Interchangeable Parts. Repairs Carried in Stock. Send for Illustrated Catalogues.

WESTINGHOUSE ENGINES

The Westinghouse Machine Co.
PITTSBURGH, PA. U.S.A.

SELLING DEPARTMENT IN THE UNITED STATES.

NEW YORK,	17 Cortlandt Street,	Westinghouse, Church, Kerr & Co.
BOSTON,	Hathaway Building,	
PITTSBURGH,	Westinghouse Building,	
CHICAGO,	156, 158 Lake Street,	
PHILADELPHIA,	608 Chestnut St.,	M. R. Muckle, Jr. & Co.
ST. LOUIS,	511 NORTH FOURTH ST.,	WESTINGHOUSE, CHURCH, KERR & CO.
SALT LAKE CITY,	259 S. Main St.	Utah & Montana Machinery Co.
BUTTE, MONT.	E. Granite St.	
SAN FRANCISCO,	21 and 23 Fremont St.,	Parke & Lacy Co.
PORTLAND, OR.	33, 35 N. Front St.,	Parke & Lacy Mch. Co.
CHARLOTTE, N. C.	36 College St.,	The D. A. Tompkins Co.
ATLANTA, GA.	45 S. Prior St.	Keating Imp. & Mch. Co.
DALLAS, TEX.		C. E. James & Co.
CHATTANOOGA, TENN.		

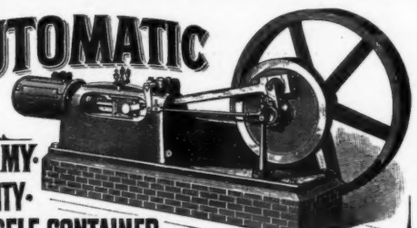
NEW ILLUSTRATED CATALOGUE NOW READY.

Contains a great variety of New Machines, and all the latest improvements on our regular manufactures.

MILLING MACHINES, SCREW MACHINES, ETC.

THE GARVIN MACHINE CO.,

Laight and Canal Sts., New York.



THE RICE AUTOMATIC

GUARANTEED ECONOMY · REGULATION · DURABILITY · SIMPLICITY · SELF-CONTAINED ·

8 TO 300 H.P. · SIMPLE, PAIR & TANDEM · COMPOUNDS ·

THE JOHN T. NOYE MFG CO. BUFFALO, N.Y.

FAIRBANKS, MORSE & CO., Western Representatives, Chicago, St. Louis, Kansas City, Omaha, Denver, St. Paul
ALBERT FISHER, 89 Liberty Street, New York, Eastern Agent.

JARVIS ENGINEERING COMPANY,

CONTRACTING ENGINEERS for ERECTING COMPLETE STEAM PLANTS
For Electric Lighting and Power Stations.

—: AGENTS FOR :—
ARMINGTON & SIMS ENGINES,
JARVIS BOILER SETTING,
to burn Anthracite Coal and Coke Screenings,
NATIONAL FEED WATER HEATER,
NATIONAL ROCKING and
SHEFFIELD GRATE BARS.

61 Oliver Street, Boston.

SEND FOR NEW CATALOGUE.

POND ENGINEERING CO.,

ENGINEERS AND CONTRACTORS.
Complete Steam Plants for Electric Light and Power.
Engines, Boilers, Furnaces, Grates, Heaters, Pumps, Injectors, Pipe Work, Belting, etc., designed with special reference to the HIGHEST EFFICIENCY.
Our Extended Experience Enables us to Guarantee Satisfaction. Send for New Illustrated Pamphlet.
ST. LOUIS, CHICAGO, KANSAS CITY AND OMAHA.

CHARLES R. VINCENT & CO.,

15 CORTLANDT STREET, NEW YORK,
Ball High Speed Automatic Cut-off Engines
MANNING VERTICAL TUBULAR BOILERS,
Complete Steam Plants Furnished and Erected.

WILLIAMS & POTTER,

15 CORTLANDT ST., NEW YORK.
Engineers & Contractors,
GENERAL AGENTS,
STRAIGHT LINE ENGINES

FRICTION CLUTCH PULLEYS

AND CUT-OFF COUPLINGS.

CHARACTERISTICS:
Vice-Like Grip of Clutches Optionally Gradual or Sudden. Large Friction Surfaces Prevent Undue Wear. Disengagement of Clutches is Positive. Pulley Shaft is Automatically Oiled. They have a Good Record. Grip of Clutches Self-Maintaining. Experts are invited to examine Peculiarities.

ECLIPSE WIND ENGINE CO.,
Send for 1889 Catalogue. Beloit, Wis.

JOHN POST, JR., & CO.,

MECHANICAL ENGINEERS.

AGENTS FOR THE
IDE AND ROLLINS ENGINES.

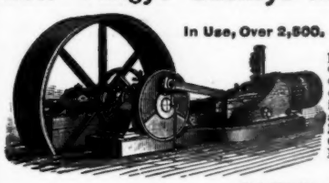
Complete Steam Plants furnished at short notice. MASON BUILDING, BOSTON.

Shultz Belting Company,

MANUFACTURERS OF
SHULTZ PATENT FULLED LEATHER BELTING AND LACE LEATHER
Office and Factory: Cor. Bismarck and Barton Sts., St. Louis, Mo.

Our Belting is made of leather tanned on the surface only; the interior (which is the fiber and strength of the hide) is not tanned but rawhide fulled and softened by our patent process. Our Belting is more pliable, hugs the pulley better, transmits more power than any other, and is the only perfect ELECTRIC LIGHT BELT MADE. Agents in all cities. Send for trial belt.

New Tangye Buckeye Automatic Cut-off Engines.



In Use, Over 2,500.

25 to 1,000 H. P.

These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and Superior regulation guaranteed. Self-contained Automatic Cut-off Engines 15 to 200 H. P. for driving Dynamo Machines a Specialty. Illustrated Circulars, with various data as to practical Steam Engine Construction and performance, free by mail.

Address BUCKEYE ENGINE CO., Salem, Ohio.

SALES AGENTS:
W. L. SIMPSON, 10 Telephone Building, 18 Cortlandt Street, N. Y.
H. W. ROBINSON, 154 Washington St., Chicago, Ill. ROBINSON & CARY, St. Paul, Minn.

16x34 DOUBLE BRAIDER.

NEW ENGLAND BUTT CO.,

Providence, R. I.,

MANUFACTURERS OF

Braiding Machinery

FOR COVERING

TELEGRAPH, TELEPHONE AND ELECTRIC-LIGHT WIRE

ALSO

SINGLE AND DOUBLE

WINDERS AND BRAIDERS

Of every Description for Silk, Worsted and Cotton Braid.

FINE CASTINGS A SPECIALTY

AMERICAN AND FOREIGN BOOKS ON ELECTRICITY AND ITS APPLICATIONS.

Electricity, Magnetism, Etc., Etc.

Adams. Essay on Electricity $4 00
Angell. Elements of Magnetism and Electricity. Cloth, 238 pages, 151 illustrations 75
Anderson. Lightning Conductors. Cloth 6 50
Atkinson. Elements of Static Electricity 1 50
Ayrton. Practical Electricity. For students of electrical engineering. 516 pages, 180 illustrations 2 50
Barlow. Magnetic Attractions 4 00
Barnard. First Steps in Electricity 75
Benjamin. Age of Electricity 2 00
Brennan. A Popular Exposition of Electricity. 191 pages 75
Blakesley. Alternating Currents of Electricity. Cloth 1 50
Bottone. The Dynamo. How Made and How Used. A book for amateurs. Cloth. 1 00
Cavendish. Electrical Researches. Cloth 5 00
Cook. Magnetism and Electricity. Cloth, 48 illustrations 40
Cumming. Electricity Treated Experimentally. Cloth, 100 diagrams 1 50
Davis. Manual of Magnetism, Galvanism, etc 3 00
Deschanel. Electricity and Magnetism. Cloth 1 50
De Fonvielle. Thunder and Lightning. Cloth, 285 pages 1 00
De La Rue. Experimental Researches in the Electric Discharge with the Chloride of Silver Battery 3 60
Du Moncel. Electro-Magnets. Boards, 50c.; English Edition 75
Dunman. Short Text Book of Electricity and Magnetism 40
Dyer. Induction Coils; How Made and How Used. Boards 50
Electricity in the Service of Man 6 00
Everett. Units and Physical Constants 1 10
Faraday. Experimental Researches in Electricity. 3 vols., cloth 20 00
Fiske. Electricity in Theory and Practice. Cloth, 270 pages, 180 illustrations 2 50
Ferguson. Electricity. Cloth 1 50
Fleming's. Short Lectures to Electrical Artisans 1 50
Francis. Electrical Experiments 2 50
Gordon. School Electricity. Cloth, 262 pages, 139 illustrations 2 00
Gordon. A Physical Treatise on Electricity and Magnetism. 2 vols., cloth 10 00
Gladstone & Tribe. The Chemistry of the Secondary Batteries of Plante and Faure. 1 00
Gordon. Four Lectures on Static Electric Induction. Cloth 80
Guthrie. Magnetism and Electricity 1 25
Hamilton. The Origin of Energy, Electrostatics and Magnetism 2 00
Heap. Electrical Appliances of the Present Day. Cloth 2 00
Hospitalier. Domestic Electricity. Cloth, 229 pages, 155 illustrations 3 00
Hospitalier. The Modern Applications of Electricity. Cloth 8 00
Harris. Rudimentary Electricity. Flexible, 69 illustrations 60
Harris. Rudimentary Magnetism. Cloth, 165 illustrations 1 40
Harris. Galvanism, Animal and Voltaic Electricity 60
Hering. Winding Magnets for Dynamos. 63 pages 1 25
Jeans. Lives of the Electricians 2 25
Jenkin. Electricity and Magnetism. Cloth, 177 illustrations 1 50
Kirwan. Modern Electricity with Glossary of Electrical Terms. 128 pages 30
Kohlrausch. Physical Measurements, with Appendices on Absolute Electrical Measurements 6 00
Lardner. Hand-Book of Electricity, Magnetism and Acoustics. 400 illustrations, cloth 2 00
Levander. Solutions of Questions in Magnetism and Electricity. Cloth 1 00
Lightning Flashes and Electric Dashes 1 00
Lloyd. Treatise on Magnetism 5 00
Lock. Workshop Receipts. Devoted mainly to Electrical and Metallurgical subjects. Cloth 2 00
Mahon. Principles of Electricity 5 00
Martin & Wetzler. Electric Motor and its Applications. 208 pages, 199 illustrations. 3 00
Mascart & Joubert. A Treatise on Electricity and Magnetism. Vol. 1, cloth, 654 pages, 127 illustrations 7 50
Maxwell. A Treatise on Electricity and Magnetism. 2 vols., 20 plates and 105 illustrations 8 00
Maxwell. An Elementary Treatise on Electricity. 6 plates, 54 illustrations 2 00
May. Bibliography of Electricity 2 00
McClure. Edison and his Inventions 1 00
Mendenhall. A Century of Electricity 1 25
Merwin. Patentability of Inventions 6 00
Miller. Magnetism and Electricity. 212 pages, illustrated 2 50
Munro. Electricity and its Uses. Cloth 1 40
Murdock. Notes on Electricity and Magnetism. Cloth, 38 illustrations 60
Munro & Jamieson. Electrician's Pocket-Book of Electrical Rules and Tables 2 50
Niaudet. Elementary Treatise on Electric Batteries. Cloth, 55 illustrations 2 50
Nipher. Theory of Magnetic Measurements 1 00
Noad. The Student's Text-Book of Electricity. Cloth, illustrated 4 00
Overend. Elementary Experiments in Magnetism and Electricity. Cloth 40
Parkinson. Ocean Telegraph to India 4 00
Parnell. Action of Lightning and Means of Defending Life and Property from its Effects 3 00
Plante. Storage of Electrical Energy. 268 pages, 89 illustrations 4 00
Pynchon. Introduction to Chemical Physics. 550 pages, 269 illustrations 3 00
Radau. Wonders of Acoustics; or, The Phenomena of Sound. Cloth, 288 pages, 116 illustrations 1 00
Rankine. Rules and Tables for Engineers 4 00
Reports of the Committee on Electrical Standards. Cloth 3 75
Rogers. Magnetism of Iron Vessels 50
Salomons. The Management of Accumulators 1 20
Spang. Treatise on Lightning Protection. Cloth, illustrated 75
Stewart & Gee. Electricity and Magnetism. 497 pages, 223 illustrations 2 25
Swinburne. Practical Electrical Units Popularly Explained. Cloth 60
Tarn. Magnetism and Electricity. A book for students 80
Techno-Chemical Receipt Book 2 00
Thompson. Elementary Lessons in Electricity and Magnetism. Cloth, 168 illustrations 1 25
Thompson. Recent Progress in Dynamo Electric Machinery 50
Thomson. Electro-Statics and Magnetism 5 00
Treglohan. Frictional Electricity 50
Tyndall. Lessons in Electricity at the Royal Institute, 1875-6. Cloth 1 00
Watson and Burbury. The Mathematical Theory of Electricity and Magnetism. Cloth, 268 pages 2 75
Wonders of Acoustics; or, The Phenomena of Sound. Cloth, 288 pages 1 00
Woodbury's Protection and Construction of Mill Floors. Cloth 2 50
Welch. Table of Relative Weights of Copper Conductors 10
Woodward. Arithmetical Physics. Boards 30

Telegraphy and Telephony.

Abernethy. Commercial and Railway Telegraphy. Illustrated, cloth 3 00
Beechey. Electro-Telegraphy. Cloth, 36 illustrations 40
Clarke & Sabine. Electrical Tables and Formulæ. Cloth 5 00
Culley. Hand-Book of Practical Telegraphy. Cloth, 442 pages 6 00
Davis & Rae. Hand-Book of Electrical Diagrams and Connections 2 00
Douglas. A Manual of Telegraph Construction. 83 diagrams, cloth 6 00
Fahie. History of Telegraphy to 1837. Cloth, 529 pages 3 00
Field. History of Atlantic Telegraph 1 25
Globe Telegraph Code 2 00
Hoskiaer. Laying and Repairing Electric Telegraph Cables. Cloth 1 50
Hoskiaer. A Guide for the Electric Testing of Telegraph Cables. Cloth 1 50
Jones. Historical Sketch of the Electric Telegraph 2 00
Lardners. Electric Telegraph Popularized 1 50
Lockwood. Electricity, Magnetism and Electric Telegraphy. Cloth, 376 pages 2 50
Loring. A Hand-Book of the Electro-Magnetic Telegraph. Boards, 50c.; cloth, 75c.; morocco 1 00
Maver & Davis. The Quadruplex. Cloth, 126 pages 1 50
Mullaly. Laying of the Cable 4 00
Pope. The Modern Practice of the Electric Telegraph. Cloth, 70 illustrations 1 50
Plum. The Military Telegraph During Our Civil War. Two vols., portraits and illustrations 5 00
Preece & Silveright. Telegraphy. Cloth 1 50
Prescott. Electricity and the Electric Telegraph. Cloth, 670 illustrations, 2 vols. 5 00
Sabine. History and Progress of the Electric Telegraph. Cloth, 134 illustrations. 1 25
Sauer. Telegraph in Europe 4 00
Schwendler. Instructions for Testing Telegraph Lines. 2 vols., cloth, illustrated. 8 00
Smith. Manual of Telegraphy. 31 illustrations, paper 30
Telegraphic Tests 5 60
Terry & Finn. Illustrations and Descriptions of Telegraphic Apparatus. Cloth, 92 pages, 30 plates 1 50
Williams. Manual of Telegraphy. Cloth, 327 pages, 90 illustrations 4 00
Dolbear. The Telephone. Cloth, illustrated 50
Du Moncel. The Telephone, the Microphone and the Phonograph. 70 illustrations, cloth 1 25
Lockwood. Practical Information for Telephonists. Cloth 1 00
Prescott. Bell's Electric Speaking Telephone. 526 pages, 330 illustrations 4 00
Thompson. Philip Reis, Inventor of the Telephone. Cloth, 3 plates and 48 engravings 3 00

Electric Lighting and Transmission of Power.

Alglave & Boulard. The Electric Light. Its History, Production and Application. 458 pages 5 00
Atkinson. Elementary Principles of Electric Lighting 1 50
Badt. Dynamo Tenders' Hand-Book. General Rules for the Care and Operation of Electric Light Plants. 70 illustrations, 93 pages 1 00
Badt. Incandescent Wiring Hand-Book 1 00
Cunynghame. A Treatise on the Law of Electric Lighting. Cloth 5 00
Day. Electric Light Arithmetic. Cloth 40
De Cew, Glacer. Magneto and Dynamo Electric Machines 3 00
Du Moncel. Electric Lighting. 66 illustrations, cloth 1 25
Dredge. Electric Illumination. 2 vols., cloth. Vol. 1 (scarce), $15. Vol. 2 ..... 7 50
Electric Lighting Act, 1882, also the Rules of Board of Trade, October, 1882 ..... 2 00
Foote. Economic Value of Electric Light and Power. 191 pages 1 00
Gordon. A Practical Treatise on Electric Lighting. Cloth 4 50
Grierson. Electric Lighting by Water Power 40
Hedge. Precautions to be Adopted on Introducing the Electric Light 1 00
Hedges. Central Station Lighting. Paper 20
Holmes. Practical Electric Lighting. Cloth 1 00
Higgs. Magneto and Dynamo Electric Machines. 301 pages 2 00
Kapp. Alternate Current Machinery 50
Maier. Arc and Glow Lamps 3 00
Pope. Evolution of the Electric Incandescent Lamp 1 00
Prescott. Dynamo-Electricity. Cloth 5 00
Stephen. Wrinkles in Electric Lighting. Cloth, 45 pages, 23 illustrations 1 00
Schellen. Magneto-Electric and Dynamo Electric Machines. Cloth 5 00
Schilling. Present Condition of Electric Lighting 50
Thompson. Dynamo-Electric Machines. Illustrated, boards 50
Thompson. Dynamo-Electric Machinery. 57 illustrations, boards 50
Thompson. Dynamo-Electric Machinery. Cloth, 527 pages, 324 illustrations 5 00
Thompson. Recent Progress in Dynamo-Electric Machinery 50
Thurston. Stationary Steam Engines, especially as adapted to Electric Lighting Purposes 2 00
Urquhart. Electric Light: its Production and Use. Cloth, 94 illustrations 3 00
Du Moncel. Electricity as a Motive Power. Cloth 3 00
Kapp. Electric Transmission of Energy and its Transformation 3 00
Urquhart. Electro-Motors. Illustrated 3 00
Walker. Practical Dynamo Building for Amateurs 80
Whipple. The Electric Railway 1 00

Testing and Measurements.

Haskins. The Galvanometer and its Uses. Morocco, 8 illustrations 1 50
Kempe. A Hand-Book of Electric Testing. Cloth, 494 pages 5 00
Lockwood. Electrical Measurements and the Galvanometer. Cloth 1 50
Smith's. Dynamometric Measurements 40
Swinburne. Practical Electrical Measurement. 55 illustrations, 155 pages 1 75

Electro-Metallurgy, Electrotyping, Etc., Etc.

Badt. Bell Hanger's Hand-Book. Practical Information and Suggestions to persons having Charge of Batteries, Bells, Annunciators and Electric Gas Lighting Apparatus. 105 pages, 97 illustrations 1 00
Bottone. Electric Bells and All About Them. Practical Instruction for Electric Bell Fitters. Over 100 illustrations, 190 pages 1 20
Bottone. Electrical Instrument Making for Amateurs 2 00
Fontaine. Electrolysis. Cloth, 264 pages 3 50
Gore. The Art of Electro-Metallurgy. Cloth, illustrated 2 25
Napier A Manual of Electro-Metallurgy. Cloth 3 00
Urquhart. Electrotyping. A Practical Manual 2 00
Urquhart. Electroplating. Cloth 2 00
Wahl. Galvanoplastic Manipulations. Cloth 7 50
Watt. Electro-Metallurgy Practically Treated. Cloth 1 00
Watt. Electro-Deposition. Cloth, 568 pages, 144 illustrations 3 50
Wilson. Stereotyping and Electrotyping. Cloth, 195 pages 2 00

☞ Copies of any of the above books will be promptly mailed, POSTAGE PREPAID, to any address in the world on receipt of price. Remit by Express or Post Office Money Order, Postal Note, Draft or Registered Letter. Address

ELECTRICAL REVIEW PUB. CO.,

P. O. BOX, 3329. 18 PARK ROW, NEW YORK.

EXTRACT FROM THE REPORT

— OF —

DR. SCHUYLER S. WHEELER,

— ON —

Underground Arc Light Wires in New York.

The line in 125th Street, 2,000 feet in length, is laid in the small ducts of the Johnstone system of conduits. The cable is a ***BISHOP GUTTA PERCHA WHITE CORE***, and was laid immediately after the order for the work was given. The cable was connected to overhead arc light wires by running it up in a two-inch iron pipe fastened to the outside of an ordinary city electric lamp post. Connections were made with lights in front of stores by carrying the cable from the ducts in iron pipes under the sidewalk and up the front of the stores. This line has been in continuous use for two months, carrying a pressure of 2,500 volts, and it shows an actual rise in insulation with age and use, as will be seen from the following tests:

Jan. 11th, 1,100 Megohms.
Feb. 12th, 1,800 Megohms.
April 12th (including eight arc lamps and branch leads), 2,000 Megohms.

All our White Core India Rubber Insulation is Same Quality as on above cables.

BISHOP GUTTA PERCHA CO.,
420-426 EAST 25TH ST., NEW YORK.

The Mitchell Vance Company

(SUCCESSOR TO MITCHELL, VANCE & CO.)

DESIGNERS AND MAKERS OF

ARTISTIC

Electroliers & Combination Fixtures

FOR ANY SYSTEM OF INCANDESCENT ELECTRIC LIGHTING.

The feeling is growing that these goods should be specially adapted to the light medium; to meet this want New Designs of Artistic merit and unexcelled finish have been originated which commend themselves to intending purchasers, being shown in Parlors illuminated by Electric light.

Architects and Decorators Designs and suggestions carried out with fidelity to the given motive.

MANUFACTORY, 24th & 25th Sts. & 10th Ave.

SALESROOMS, No. 836 & 838 BROADWAY,

NEW YORK.

Powell's Patent "Signal"

DYNAMO OILERS.

THE BEST IN THE WORLD.

The Filling Hole in top Cap is covered with Snap Lever, which can not be displaced by jarring or shaking of machinery.

Sight chamber is fitted with square window panes, which are secured by brass end plates, and can be removed for inspection, cleaning or repairs, at any time, while the machine is running.

Shows all dropping while machinery runs.

Fig. 2.

Shows feed at all stopped when machinery stops.

Flow of oil can be instantly stopped or started, without changing degree of feed.

MANUFACTURED BY
THE WM. POWELL CO.,
Nos. 50, 52 & 54 Plum St., CINCINNATI, O.

Please send for Prices and Discounts.

WRITE For the Electrical Review's *New Catalogue* of all Electrical and Scientific Books.
18 PARK ROW, NEW YORK.

CARBON PLATES & CARBON BATTERIES

ELECTRIC LIGHT CARBONS.

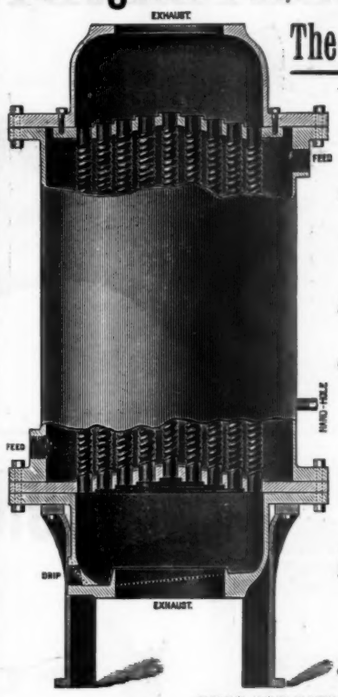
MADE FROM NATURAL GAS BY PATENTED PROCESS.

— ADDRESS —

SOLAR CARBON & MANUFACTURING CO.,
95 & 97 FIFTH AVE., PITTSBURGH, PA.

THE IMPROVED

Corrugated Tube Feed Water Heater.



The Wainwright Mfg. Co.

of Massachusetts,

SOLE MANUFACTURERS OF THE

Corrugated Tube Feed Water Heaters,

Surface Condensers, Expansion Joints,

Expansion Tubes for Compoud Engines,

Coil and Straight Tube, Vertical or Horizontal,

Feed Water Heaters,

Harvard Pump Regulators,

Automatic Gauge Valves, Barnard's Separator.

All Heaters and Condensers Sold Under Ten Years' Guarantee.

The Highest Known Results from the Use of Exhaust Steam without Back Pressure.

SEND FOR CATALOGUE "A" TO
34 OLIVER STREET, BOSTON.
F. B. ASPINWALL, 112 Liberty St., N. Y. H. S. WALKER, 26-28 W. Randolph St., Chicago.
ST. LOUIS MECH. SUPPLY COMPANY, St. Louis and Kansas City, Mo.

THE WESTON STANDARD

VOLTMETERS AND AMMETERS.

These instruments are the most accurate, reliable and sensitive, portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

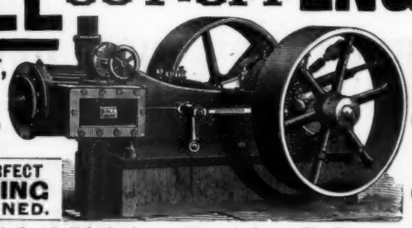
SEND FOR ILLUSTRATED CATALOGUE.

Address,

WESTON ELECTRICAL INSTRUMENT CO.,
Quitman, near Baldwin St., NEWARK, N. J.

BALL AUTOMATIC CUT-OFF ENGINE

RELIABILITY,
ECONOMY,
SIMPLICITY,
DURABILITY.
THE MOST PERFECT GOVERNING EVER OBTAINED.



STANDARD
DOUBLE COMPOUND
TANDEM COMPOUND

For Electrical Lighting, Electrical Railways and purposes where perfect governing is required, it has no equal.

BALL ENGINE CO., ERIE, PA.

GRIMSHAW WHITE CORE INSULATED WIRE

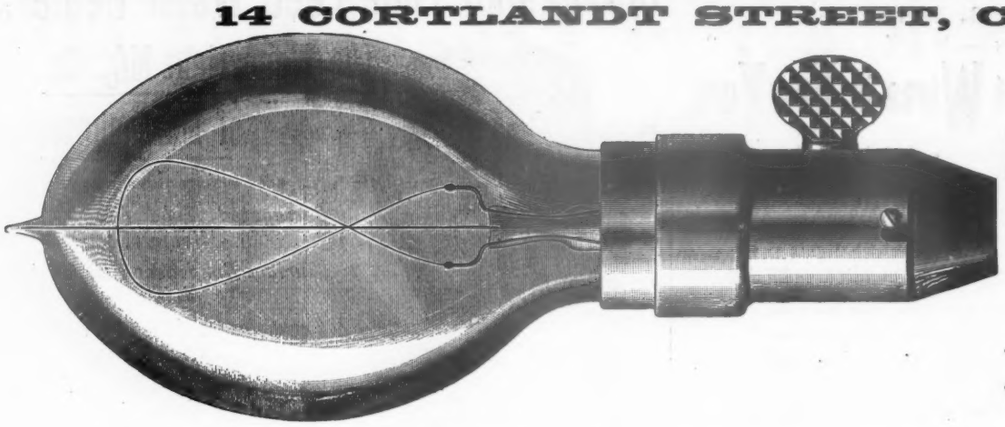
Grimshaw Patented White Core WIRES and CABLES.

FIRE, ACID, AND WATERPROOF. GRIMSHAW TAPE.

NEW YORK INSULATED WIRE Co.,
R. E. Gallaher, Secretary. J. W. Godfrey, Gen'l Manager. W. B. Dowse, Treasurer.
Sole Manufacturers,
649 & 651 BROADWAY, N. Y.

SEELY & TAYLOR M'F'G CO.,

14 CORTLANDT STREET, CITY.

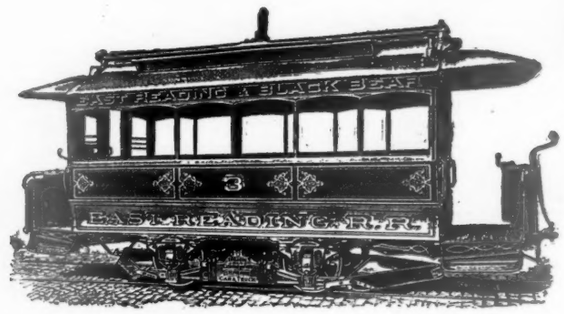


SOLE AGENTS
— FOR —
BACKSTROM'S
Incandescent Lamps.

LAMPS MADE
TO FIT ALL SOCKETS.

J. A. SEELY, President.
J. A. TAYLOR, Sec'y and Treas.

WRITE FOR CATALOGUE.



JOHN STEPHENSON COMPANY

LIMITED,

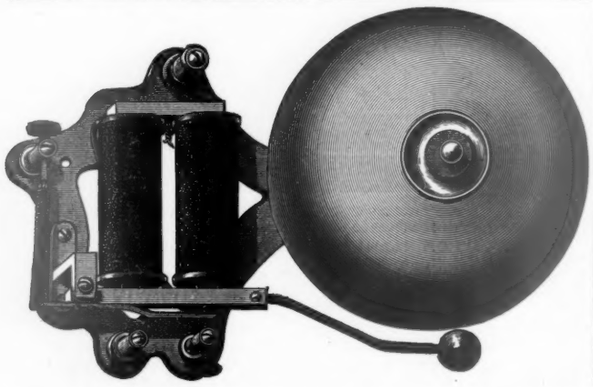
NEW YORK.

Street Cars

FOR

Electric Motors.

Manufacturers



H. E. & C. BAXTER,
18 Fulton Street, Brooklyn, E. D.

Industries.

— A —

Journal of Engineering, Electricity & Chemistry

— FOR THE —

MECHANICAL AND MANUFACTURING TRADES.

PUBLISHED EVERY FRIDAY.

ANNUAL SUBSCRIPTIONS.	Thick Paper.	Thin Paper.
GREAT BRITAIN, Post Free	$6 00	$6 00
THE UNITED STATES, CANADA and COUNTRIES INCLUDED IN THE POSTAL UNION, Post Free	9 00	8 00
INDIA, CEYLON, STRAITS SETTLEMENTS, CHINA, JAPAN, &c., Post Free	10 75	9 00

SUBSCRIPTIONS PAYABLE IN ADVANCE TO

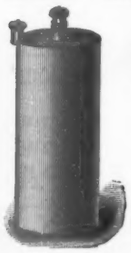
GEO. CAWLEY, 358 STRAND, LONDON, W. C.

Manchester, 70 Market St.; Glasgow, 93 Hope St.; Yokohama (Japan), 32 Main St.

American Subscriptions to "Industries" are received by the Publisher of the ELECTRICAL REVIEW, 13 Park Row, New York.

DR. GASSNER'S DRY BATTERY.

Acknowledged by experts to be the Best Open Circuit Battery in the Market, the most durable and convenient for



Electric Bells, Gas Lighting, Telephones, Signals, Electric Clocks, Stationary Batteries for Physicians and Many Other Uses.

No Liquid. No Glass.

HIGHEST TESTIMONALS. WRITE FOR CIRCULAR.

For Sale by The Western Electric Co. CHICAGO, ILL.
And California Electrical Works, SAN FRANCISCO, CAL.

A. SCHOVERLING,
SOLE AGENT AND MANUFACTURER,
111 Chambers Street, New York.

EDISON MACHINE WORKS,

Schenectady, N. Y.

MANUFACTURERS OF

INSULATED WIRES, FLEXIBLE CORDS AND CABLES,

—FOR—

Telephone, Telegraph and Electric Light.

JAMES F. KELLY.

GENERAL SALES AGENT,

19 Dey Street, New York.

SAWYER-MAN ELECTRIC CO.

Incandescent Lamps and General Electrical Supplies.

"The lamps of the Sawyer-Man pattern in use on board (S. S. 'Omaha') in many instances have shown a remarkably long life, several having a record of from 5,000 to 7,000 hours each."—Extract from Report of Commander R. B. Bradford, Inspector of Electric Lighting, to the Chief of the Bureau of Navigation, Navy Department, for 1889, page 27.

GENERAL OFFICES:

510-534 West 23d St., New York.

CENTRAL ELECTRIC COMPANY,

116 and 118 Franklin Street,

CHICAGO.

Every central station man should have one of Davis' Hand Books containing 130 pages of just the right sort of information, with 30 illustrations, all bound in convenient form for the pocket.

Among the contents are articles on the Arc Lamp, the Incandescent Lamp, Batteries, Boilers, Dynamos, Electrical Units, General Formulæ for Wiring for any System, the Steam Engine, Rules for Computing Speed and Diameters of Pulleys, various Wire Gauges, the Electric Motor, Rules of various Underwriters' Associations, Storage Batteries, all compiled by a practical man who knows from experience what is needed.

Price, in Cloth, $0 75. Price, in Leather, $1 50.

Central Electric Company,

116 and 118 Franklin Street, Chicago.

GIVES MORE POWER USING LESS WATER THAN ANY OTHER WHEEL.

THE OLD RELIABLE —LEFFEL— WATER WHEEL. SEND FOR CATALOGUE.

JAMES LEFFEL & CO. SPRINGFIELD, O., OR 110 LIBERTY ST., N.Y.

BROWNLEE & CO.
DETROIT, MICH.,
DEALERS IN
Poles, Cross Arms, Pins, Etc.

RED PINE OCTAGONAL POLES
for electric railways and electric lighting. Perfectly straight. The handsomest, strongest and most satisfactory pole in the market. 24 to 34 feet in length.

CEDAR TELEGRAPH POLES
of all sizes always in stock.

CROSS ARMS AND PINS
at lowest prices.

SEND FOR CIRCULARS.

THACKARA MANUFACTURING CO.,
DESIGNERS AND MAKERS OF
GAS, ELECTRIC AND COMBINATION FIXTURES
For any Incandescent System.
Philadelphia, Pa.

BOOKS ON ELECTRICAL SUBJECTS
Will be mailed to any address, postage prepaid, on receipt of price. Address,
ELECTRICAL REVIEW PUB. COMPANY,
13 Park Row, New York. P. O. Box, 3,329.

WRITE For the Electrical Review's *New Catalogue* of all Electrical and Scientific Books.
18 PARK ROW, NEW YORK.

AWARDED THE GRAND PRIZE

AT LATE PARIS EXPOSITION.

Something New! One, two, three, and four spindle drills for light work.

DRILLS

The most useful patented improvement in drill presses for years is applied.

SENSITIVE

Spindles driven with single, endless belts. Large driving pulleys, tightener and variable speeds provided.

Over 1,000 in use. Buy the **latest** and **best**. Special machinery to order. Catalogue of fine tools free.

Dwight Slate Machine Co.
HARTFORD, CONN.

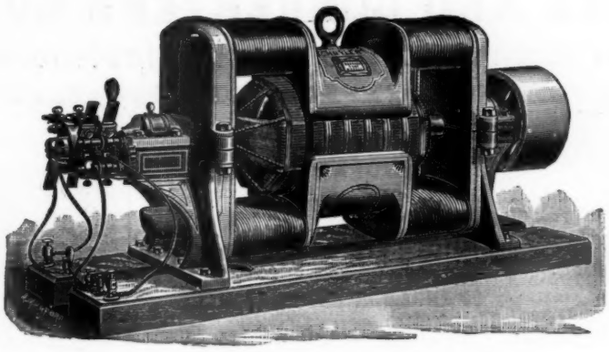
REGISTER SPRINGS A SPECIALTY.

THE

SCHUYLER ARC LIGHTING SYSTEM

Perfect Automatic Regulation.
Absolutely Steady Lights.

IMPROVED SCHUYLER DYNAMO,



WITH VENTILATED ARMATURE.

The Ventilated Armature Ensures a Cool Running Machine and No Burnouts.

THE SCHUYLER ELECTRIC CO., MIDDLETOWN, CONN.

Edison Lamps

½ to 36 CANDLE POWER.
2½ to 40 VOLTS.
For Battery or Dynamo.

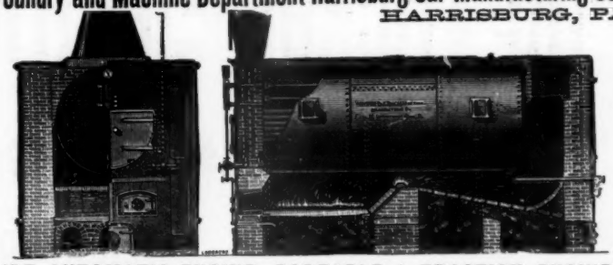
These Lamps can be used in Series on Dynamo Circuits for all kinds of Decorations and Displays.

SEND FOR CATALOGUE
— OF —
LOW VOLT LAMPS

EDISON LAMP CO., HARRISON, N. J.

Weitmyer Patent Furnace,

MANUFACTURED AND SOLD BY
Foundry and Machine Department Harrisburg Car Manufacturing Co.
HARRISBURG, PA.



IDE AUTOMATIC ENGINE, PORTABLE & TRACTION ENGINES.
STEAM ROAD ROLLERS, BOILERS OF ALL DESCRIPTIONS.

New York Office, Messrs. Fleming & Kimball, 17 Dey Street.
New England Office, Messrs. John Post, Jr. & Co., 70 Kilby St., Boston.
Baltimore Office, Messrs. Thomas K. Carey & Bro., 26 Light St., Balt.

WESTERN OFFICE, MESSRS. ENGLISH, MORSE & CO. KANSAS CITY, MO.

NEW ELECTRICAL BOOKS.

PRACTICAL ELECTRIC NOTES AND DEFINITIONS.

Designed for the Use of Engineering Students and Practical Men.

BY

W. PERREN MAYCOCK.

TOGETHER WITH

The Rules and Regulations to be observed in Electrical Installation Work.

PRICE, - - - 60 CENTS.

PRACTICAL ELECTRICS.

A UNIVERSAL HANDY BOOK

ON

Everyday Electrical Matters,

INCLUDING

CONNECTIONS, ALARMS, BATTERIES, CELLS, CARBONS, Etc., Etc.

A Convenient Reference Book for those having Electric Bells, Telephones or Electric Lights, in their Houses.

PRICE, - - - 75 CENTS.

EXPERIMENTAL SCIENCE.

BY

GEO. M. HOPKINS.

TREATING THE VARIOUS TOPICS OF PHYSICS IN A POPULAR AND PRACTICAL WAY. IT DESCRIBES THE APPARATUS IN DETAIL AND EXPLAINS EXPERIMENTS IN FULL TO ENABLE STUDENTS TO MAKE APPARATUS WITHOUT MUCH EXPENSE.

PRICE, - - - - $4 00.

MODERN VIEWS OF ELECTRICITY.

BY

OLIVER J. LODGE.

Explaining without Technicalities and Illustrating by Mechanical Models and Analogies, the Position of Thinkers on Electrical Subjects at the Present Time.

PRICE, - - - - $2 00.

Copies of any of the above works sent, postage prepaid, on receipt of price.

ELECTRICAL REVIEW,

P. O. Box 3329. 13 PARK ROW, NEW YORK.

Fort Wayne Electric Company,

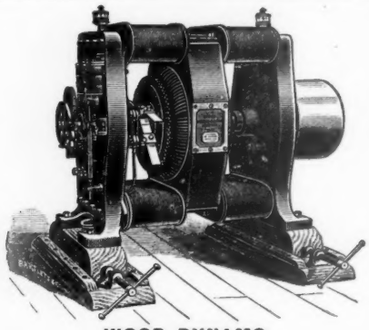
FORT WAYNE, IND.

The most carefully worked out and Complete Alternating System of Electric Lighting in existence.

ARMATURES AND CONVERTERS GUARANTEED.

12 16-candle-power Lamps to the mechanical horse power guaranteed

CORRESPONDENCE SOLICITED.



WOOD DYNAMO.

MANUFACTURERS

—OF THE—

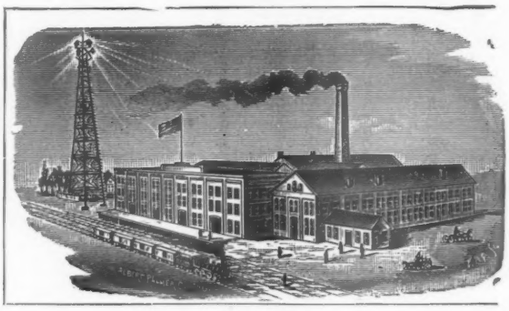
Slattery Induction System

OF INCANDESCENT LIGHTING,

—AND THE—

"WOOD" SYSTEM

OF ARC LIGHTING.



Main Office and Works, Fort Wayne, Ind.

NEW YORK OFFICE, Rooms 25 and 27, 115 BROADWAY,

H. C. ADAMS, Manager.

Manhattan Electric Light Co., 511 Broadway, Sole Licensees and Agents for N. Y. City and Brooklyn

CHICAGO OFFICE, 185 Dearborn St., W. J. BUCKLEY, Manager.

PHILADELPHIA OFFICE, 907 Filbert St., G. A. WILBUR, Manager.

PITTSBURGH OFFICE, 533 WOOD STREET,

SAN FRANCISCO OFFICE, 217 SANSOME STREET

F. ADAMS SUC'S, CITY OF MEXICO.

The Tucker Electrical Construction Co.

GENERAL CONTRACTORS,

AUTHORIZED AGENTS OF THE

MATHER ELECTRIC CO.

Of Manchester, Conn.,

AND THE

PERKINS ELECTRIC LAMP COMPANY,

Of Hartford, Conn.

14-20 WHITEHALL ST., NEW YORK CITY.